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15 *Attorneys for Plaintiffs and the
the Proposed Class*

16 UNITED STATES DISTRICT COURT
17 NORTHERN DISTRICT OF CALIFORNIA
18 SAN FRANCISCO DIVISION

19 IN RE SEAGATE TECHNOLOGY LLC
20 LITIGATION

No. 3:16-cv-00523-JCS

21 DECLARATION OF SHANA E.
22 SCARLETT IN SUPPORT OF
23 PLAINTIFFS' RENEWED MOTION
24 FOR CLASS CERTIFICATION

25 DATE: January 18, 2018
26 TIME: 9:30 a.m.
27 DEPT: Hon. Joseph C. Spero
28 Courtroom G, 15th Floor

1 I, SHANA E. SCARLETT, declare as follows:

2 1. I am a partner at the law firm Hagens Berman Sobol Shapiro LLP, attorneys for
3 plaintiffs in the above-titled action. I have personal knowledge of the matters stated herein and, if
4 called upon, I could and would competently testify thereto.

5 2. Plaintiffs sought a stipulation from defendants, which Seagate declined. Plaintiffs
6 originally sought an extension of ten pages to the twenty-five page limit. Seagate indicated the
7 extension of pages would only be granted in exchange for an extension in their time to oppose the
8 motion by more than a month.

9 3. Attached hereto are true and correct copies of the following exhibits:

- 10 Exhibit 1: Document Bates-numbered FED SEAG0027180-81, produced in the above-
11 captioned litigation by Defendant Seagate in this action;
- 12 Exhibit 2: Document Bates-numbered FED SEAG0015567-68, produced in the above-
13 captioned litigation and designated "CONFIDENTIAL" by Defendant
14 Seagate pursuant to the protective order in this action;
- 15 Exhibit 3: Document Bates-numbered FED SEAG0019045-9094, produced in the
16 above-captioned litigation and designated "CONFIDENTIAL" by Defendant
17 Seagate pursuant to the protective order in this action;
- 18 Exhibit 4: Captured image of Seagate ST3000DM001 product specifications as it
19 appeared on November 29, 2011, *available at*
20 [https://web.archive.org/web/20111129033926/http://www.seagate.com:80/www/en-](https://web.archive.org/web/20111129033926/http://www.seagate.com:80/www/en-us/products/desktops/barracuda_hard_drives#TabContentSpecifications)
21 [us/products/desktops/barracuda_hard_drives#TabContentSpecifications](https://web.archive.org/web/20111129033926/http://www.seagate.com:80/www/en-us/products/desktops/barracuda_hard_drives#TabContentSpecifications);
- 22 Exhibit 5: Captured image of Seagate Barracuda product specifications as it appeared
23 on April 28, 2012, *available at*
24 [https://web.archive.org/web/20120428124406/http://www.seagate.com:80/in-](https://web.archive.org/web/20120428124406/http://www.seagate.com:80/internal-hard-drives/desktop-hard-drives/)
25 [ternal-hard-drives/desktop-hard-drives](https://web.archive.org/web/20120428124406/http://www.seagate.com:80/internal-hard-drives/desktop-hard-drives/);
- 26 Exhibit 6: Captured image of Seagate Desktop HDD product specifications as it
27 appeared on January 24, 2014, *available at*
28 [https://web.archive.org/web/20140124073650/http://www.seagate.com/inter-](https://web.archive.org/web/20140124073650/http://www.seagate.com/internal-hard-drives/desktop-hard-drives/)
[nal-hard-drives/desktop-hard-drives/](https://web.archive.org/web/20140124073650/http://www.seagate.com/internal-hard-drives/desktop-hard-drives/);
- Exhibit 7: Document Bates-numbered FED SEAG0004438-475, produced in the
above-captioned litigation and designated "CONFIDENTIAL" by Defendant
Seagate pursuant to the protective order in this action;
- Exhibit 8: Excerpts from the 30(b)(6) Deposition of Seagate Technology, LLC (given
by Glen Almgren), taken in the above-captioned litigation on July 26, 2017;
- Exhibit 9: Seagate Technology, LLC's Third Amended Response to Plaintiffs' First Set
of Interrogatories, Nos. 9 and 10, served on February 8, 2018 and designated

1 “CONFIDENTIAL” by Defendant Seagate pursuant to the protective order
2 in this action;

3 Exhibit 10: Excerpts from the 30(b)(6) Deposition of Seagate Technology, LLC (given
4 by Patrick Dewey), taken in the above-captioned litigation on September 7,
5 2017;

6 Exhibit 11: Defendant Seagate Technology LLC’s Responses to Plaintiff Christopher
7 Nelson’s Second Set of Interrogatories, served on October 5, 2018 and
8 designated as “CONFIDENTIAL” by Defendant Seagate pursuant to the
9 protective order in this action;

10 Exhibit 12: Excerpts from the Videotaped Deposition of Dennis Crawford, taken in the
11 above-captioned litigation on June 15, 2017;

12 Exhibit 13: Document Bates-numbered FED SEAG0076615-76701, produced in the
13 above-captioned litigation and designated “CONFIDENTIAL” by Defendant
14 Seagate pursuant to the protective order in this action;

15 Exhibit 14: Excerpt from document Bates-numbered FED SEAG0093489, produced in
16 the above-captioned litigation and designated “HIGHLY CONFIDENTIAL
17 – ATTORNEYS’ EYES ONLY” by Defendant Seagate pursuant to the
18 protective order in this action;

19 Exhibit 15: Seagate Barracuda data sheet, dated November 2011;

20 Exhibit 16: Seagate Storage Solutions guide, dated July 2012, *available at*
21 [https://www.seagate.com/files/www-content/product-content/_cross-](https://www.seagate.com/files/www-content/product-content/_cross-product/en-us/docs/storage-solutions-guide-sg1351-11-1210us.pdf)
22 [product/en-us/docs/storage-solutions-guide-sg1351-11-1210us.pdf](https://www.seagate.com/files/www-content/product-content/_cross-product/en-us/docs/storage-solutions-guide-sg1351-11-1210us.pdf);

23 Exhibit 17: Document Bates-numbered FED SEAG0031474-1513, produced in the
24 above-captioned litigation by Defendant Seagate in this action;

25 Exhibit 18: Seagate Storage Solutions Guide dated October 2013, *available at*
26 [https://www.seagate.com/files/www-content/product-content/_cross-](https://www.seagate.com/files/www-content/product-content/_cross-product/en-us/docs/storagesolution-guide-oct-13-ssg1351-14-1310us.pdf)
27 [product/en-us/docs/storagesolution-guide-oct-13-ssg1351-14-1310us.pdf](https://www.seagate.com/files/www-content/product-content/_cross-product/en-us/docs/storagesolution-guide-oct-13-ssg1351-14-1310us.pdf);

28 Exhibit 19: Documents Bates-numbered FED SEAG0004783-4810, produced in the
above-captioned litigation and designated “CONFIDENTIAL” by Defendant
Seagate pursuant to the protective order in this action;

Exhibit 20: Document Bates-numbered FED SEAG0002109-110, produced in the
above-captioned litigation and designated “CONFIDENTIAL” by Defendant
Seagate pursuant to the protective order in this action;

Exhibit 21: Document Bates-numbered FED SEAG0012340-364, produced in the
above-captioned litigation and designated “CONFIDENTIAL” by Defendant
Seagate pursuant to the protective order in this action;

Exhibit 22: Document Bates-numbered FED SEAG0056563-6642, produced in the
above-captioned litigation and designated “HIGHLY CONFIDENTIAL” by
Defendant Seagate pursuant to the protective order in this action;

Exhibit 23: Document Bates-numbered FED SEAG0009670-9702, produced in the
above-captioned litigation and designated “CONFIDENTIAL” by Defendant

Seagate pursuant to the protective order in this action;

Exhibit 24: Documents Bates-numbered FED_SEAG0055127-132 and FED_SEAG0054972-77, produced in the above-captioned litigation and designated "CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 25: Document Bates-numbered FED_SEAG0055922-56034, produced in the above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 26: Document Bates-numbered FED_SEAG0063104-139, produced in the above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 27: Document Bates-numbered FED_SEAG0060976-982, produced in the above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 28: Document Bates-numbered FED_SEAG0006071-74, produced in the above-captioned litigation and designated "CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 29: Document Bates-numbered FED_SEAG0067917-19, produced in the above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 30: Document Bates-numbered FED_SEAG0067889-7900, produced in the above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 31: Document Bates-numbered FED_SEAG0055041-46, produced in the above-captioned litigation and designated "CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 32: Document Bates-numbered FED_SEAG0055831-849, produced in the above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 33: Document Bates-numbered FED_SEAG0059618-629, produced in the above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 34: Document Bates-numbered FED_SEAG0026751-794, produced in the above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 35: Document Bates-numbered FED_SEAG0057277-7403, produced in the above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

Exhibit 36: Documents Bates-numbered FED_SEAG0072642-651 and FED_SEAG0072382-89, produced in the above-captioned litigation and designated "CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action;

- 1 Exhibit 37: Document Bates-numbered FED_SEAG0006442-45, produced in the above-
- 2 captioned litigation and designated "CONFIDENTIAL" by Defendant
- 3 Seagate pursuant to the protective order in this action;
- 4 Exhibit 38: Document Bates-numbered FED_SEAG0072676-681, produced in the
- 5 above-captioned litigation and designated "CONFIDENTIAL" by Defendant
- 6 Seagate pursuant to the protective order in this action;
- 7 Exhibit 39: Document Bates-numbered FED_SEAG0072348, produced in the above-
- 8 captioned litigation and designated "CONFIDENTIAL" by Defendant
- 9 Seagate pursuant to the protective order in this action;
- 10 Exhibit 40: Document Bates-numbered FED_SEAG0071790-1803, produced in the
- 11 above-captioned litigation and designated "CONFIDENTIAL" by Defendant
- 12 Seagate pursuant to the protective order in this action;
- 13 Exhibit 41: Document Bates-numbered FED_SEAG0071982-86, produced in the above-
- 14 captioned litigation and designated "CONFIDENTIAL" by Defendant
- 15 Seagate pursuant to the protective order in this action;
- 16 Exhibit 42: Document Bates-numbered FED_SEAG0071996-72006, produced in the
- 17 above-captioned litigation and designated "CONFIDENTIAL" by Defendant
- 18 Seagate pursuant to the protective order in this action;
- 19 Exhibit 43: Document Bates-numbered FED_SEAG0057214-16, produced in the above-
- 20 captioned litigation and designated "HIGHLY CONFIDENTIAL" by
- 21 Defendant Seagate pursuant to the protective order in this action;
- 22 Exhibit 44: Document Bates-numbered FED_SEAG0002673-680, produced in the
- 23 above-captioned litigation and designated "CONFIDENTIAL" by Defendant
- 24 Seagate pursuant to the protective order in this action;
- 25 Exhibit 45: Document Bates-numbered FED_SEAG0055784-86, produced in the above-
- 26 captioned litigation and designated "HIGHLY CONFIDENTIAL" by
- 27 Defendant Seagate pursuant to the protective order in this action;
- 28 Exhibit 46: Document Bates-numbered FED_SEAG0024743-763, produced in the
- above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by
- Defendant Seagate pursuant to the protective order in this action;
- Exhibit 47: Article entitled, "What Can 49,056 Hard Drives Tell Us? Hard Drive
- Reliability Stats for Q# 2015," dated October 14, 2015, *available at*
- <https://www.backblaze.com/blog/hard-drive-reliability-q3-201>;
- Exhibit 48: Document Bates-numbered FED_SEAG0025567-572, produced in the
- above-captioned litigation and designated "HIGHLY CONFIDENTIAL" by
- Defendant Seagate pursuant to the protective order in this action;
- Exhibit 49: Article entitled, "CSI: Backblaze – Dissecting 3TB Drive Failure, dated
- April 15, 2015, *available at* [https://www.backblaze.com/blog/3tb-hard-](https://www.backblaze.com/blog/3tb-hard-drive-failure/)
- [drive-failure/](https://www.backblaze.com/blog/3tb-hard-drive-failure/);
- Exhibit 50: Document Bates-numbered FED_SEAG0010073-10082, produced in the
- above-captioned litigation and designated "CONFIDENTIAL" by Defendant

Seagate pursuant to the protective order in this action;

Exhibit 51: Document Bates-numbered FED_SEAG0025642-46, produced in the above-captioned litigation and designated “HIGHLY CONFIDENTIAL” by Defendant Seagate pursuant to the protective order in this action;

Exhibit 52: Document Bates-numbered FED_SEAG0001851-881, produced in the above-captioned litigation and designated “CONFIDENTIAL” by Defendant Seagate pursuant to the protective order in this action;

Exhibit 53: Excerpt from document Bates-numbered FED_SEAG0090915, produced in the above-captioned litigation and designated “HIGHLY CONFIDENTIAL – ATTORNEYS’ EYES ONLY” by Defendant Seagate pursuant to the protective order in this action;

Exhibit 54: Excerpt from document Bates-numbered FED_SEAG0090943, produced in the above-captioned litigation and designated “HIGHLY CONFIDENTIAL – ATTORNEYS’ EYES ONLY” by Defendant Seagate pursuant to the protective order in this action;

Exhibit 55: Defendant Seagate Technology LLC’s Supplemental Responses to Plaintiff Christopher Nelson’s First Set of Interrogatories, served by Defendant on August 18, 2017 and designated “HIGHLY CONFIDENTIAL” by Defendant Seagate pursuant to the protective order in this action;

Exhibit 56: Excerpts from the Deposition of Jeffrey Fochtman, taken in the above-captioned litigation on August 18, 2017;

Exhibit 57: Excerpts from the Videotaped Deposition of Joshua Enders, taken in the above-captioned litigation on June 7, 2017;

Exhibit 58: Excerpts from the Videotaped Deposition of David Schechner, taken in the above-captioned litigation on June 6, 2017;

Exhibit 59: Excerpts from the Videotaped Deposition of James Hagey, taken in the above-captioned litigation on July 24, 2017;

Exhibit 60: Excerpts from the Videotaped Deposition of Nikolas Manak, taken in the above-captioned litigation on June 20, 2017;

Exhibit 61: Declaration of Derek Noer, dated November 7, 2017;

Exhibit 62: Declaration of Office Depot, Inc., dated November 7, 2017;

Exhibit 63: Summary chart of Seagate AFR rates;

Exhibit 64: Document Bates-numbered FED_SEAG0072362, produced in the above-captioned litigation and designated “CONFIDENTIAL” by Defendant Seagate pursuant to the protective order in this action;

Exhibit 65: Document Bates-numbered FED_SEAG0054972-77, produced in the above-captioned litigation and designated “CONFIDENTIAL” by Defendant Seagate pursuant to the protective order in this action; and

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Exhibit 66: Document Bates-numbered FED_SEAG0072382-89, produced in the above-captioned litigation and designated "CONFIDENTIAL" by Defendant Seagate pursuant to the protective order in this action.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed this 15th day of October, 2018 at Berkeley, California.

s/ Shana E. Scarlett
SHANA E. SCARLETT

EXHIBIT 2



Data Sheet

Barracuda®

The Power of One

Key Advantages

- Double your capacity and drive down costs with the industry's first 1TB-per-disk hard drive technology.
- Up to 3TB capacity with 7200-RPM performance. Why compromise?
- SATA 6Gb/s interface optimizes burst performance
- Seagate AcuTrac™ servo technology delivers dependable performance, even with hard drive track widths of only 75 nanometers.
- Seagate OptiCache™ technology boosts overall performance by as much as 45% over the previous generation.
- Seagate SmartAlign™ technology provides a simple, transparent migration to Advanced Format 4K sectors.
- Free Seagate DiscWizard™ software allows you to install a 3TB hard drive in Windows, including XP, without UEFI BIOS.

Best-Fit Applications

- Desktop or all-in-one PCs
- Home servers
- PC-based gaming systems
- Desktop RAID
- Direct-attached external storage devices (DAS)
- Network-attached storage devices (NAS)



Barracuda®

The Power of One



Specifications	3TB ¹	2TB ¹	1.5 ¹ TB	1TB ¹	75 ¹ QGB	5 ¹ QGB	320GB ¹	25 ¹ QGB
Model Number	ST3000DM001	ST2000DM001	ST1500DM003	ST1000DM003	ST750DM003	ST500DM002 ²	ST320DM000 ²	ST250DM000 ²
Interface Options	SATA 6Gb/s NQ	SATA 6Gb/s NQ	SATA 6Gb/s NQ	SATA 6Gb/s NQ	SATA 6Gb/s NQ	SATA 6Gb/s NQ	SATA 6Gb/s NQ	SATA 6Gb/s NQ
Performance								
Spindle Speed (RPM)	7200	7200	7200	7200	7200	7200	7200	7200
Cache, Multisegmented (MB)	64	64	64	64	64	16	16	16
SATA Transfer Rates Supported (Gb/s)	6.0/3.0/1.5	6.0/3.0/1.5	6.0/3.0/1.5	6.0/3.0/1.5	6.0/3.0/1.5	6.0/3.0/1.5	6.0/3.0/1.5	6.0/3.0/1.5
Seek Average, Read (ms)	<8.5	<8.5	<8.5	<8.5	<8.5	<11	<11	<11
Seek Average, Write (ms)	<9.5	<9.5	<9.5	<9.5	<9.5	<12	<12	<12
Average Data Rate, Read/Write (MB/s)	156	156	156	156	156	125	125	125
Max Sustained Data Rate, CD Read (MB/s)	210	210	210	210	210	144	144	144
Configuration/Organization								
Heads/Disks	6/3	6/3	4/2	2/1	2/1	2/1	2/1	1/1
Bytes per Sector	4096	4096	4096	4096	4096	4096 or 512 ²	4096 or 512 ²	4096 or 512 ²
Voltage								
Voltage Tolerance, Including Noise (5V)	+10%/-5.0%	+10%/-5.0%	+10%/-5.0%	+10%/-5.0%	+10%/-5.0%	+10%/-5.0%	+10%/-5.0%	+10%/-5.0%
Voltage Tolerance, Including Noise (12V)	+10%/-7.5%	+10%/-7.5%	+10%/-7.5%	+10%/-7.5%	+10%/-7.5%	+10%/-7.5%	+10%/-7.5%	+10%/-7.5%
Reliability/Data Integrity								
Contact Start/Stop Cycles	—	—	—	—	—	50,000	50,000	50,000
Load/Unload Cycles	300,000	300,000	300,000	300,000	300,000	—	—	—
Nonrecoverable Read Errors per Bits Read, Max	1 per 10E14	1 per 10E14	1 per 10E14	1 per 10E14	1 per 10E14	1 per 10E14	1 per 10E14	1 per 10E14
Annualized Failure Rate (AFR)	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Power-On Hours	2400	2400	2400	2400	2400	2400	2400	2400
Power Management								
Startup Power (A)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Operating Mode, Typical (W)	8.0	8.0	6.70	5.90	5.90	6.19	6.19	6.19
Idle2 Average (W)	5.40	5.40	4.50	3.36	3.36	—	—	—
Idle Average (W)	—	—	—	—	—	4.60	4.60	4.60
Standby Mode (W)	0.75	0.75	0.75	0.63	0.63	0.79	0.79	0.79
Sleep Mode (W)	0.75	0.75	0.75	0.63	0.63	0.79	0.79	0.79
Environmental								
Temperature								
Operating (ambient min °C)	0	0	0	0	0	0	0	0
Operating (drive case max °C)	60	60	60	60	60	60	60	60
Nonoperating (ambient °C)	-40 to 70	-40 to 70	-40 to 70	-40 to 70	-40 to 70	-40 to 70	-40 to 70	-40 to 70
Physical								
Height (mm/in)	26.11/1.028	26.11/1.028	26.11/1.028	20.17/0.7825	20.17/0.7825	19.98/0.787	19.98/0.787	19.98/0.787
Width (mm/in)	101.6/4.0	101.6/4.0	101.6/4.0	101.6/4.0	101.6/4.0	101.6/4.0	101.6/4.0	101.6/4.0
Depth (mm/in)	146.99/5.787	146.99/5.787	146.99/5.787	146.99/5.787	146.99/5.787	146.99/5.787	146.99/5.787	146.99/5.787
Weight (g/lb)	626/1.38	626/1.38	535/1.18	400/0.88	400/0.88	415/0.92	415/0.92	415/0.92
Carton Unit Quantity	20	20	20	25	25	25	25	25
Cartons per Layer	40	40	40	40	40	40	40	40
Cartons per Pallet	8	8	8	8	8	8	8	8
Special Features								
Seagate OptiCache™ Technology	Yes	Yes	Yes	Yes	Yes	No	No	No
Seagate AcuTrac™ Technology	Yes	Yes	Yes	Yes	Yes	No	No	No
Seagate SmartAlign™ Technology	Yes	Yes	Yes	Yes	Yes	Yes ²	Yes ²	Yes ²

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.

² Seagate ships this drive in both 4K- and 512-byte sectors. SmartAlign technology is included on 4K sector drives. Both drives are functionally and physically equivalent.

www.seagate.com



AMERICAS Seagate Technology LLC 10200 South De Anza Boulevard, Cupertino, California 95014, United States, 408-658-1000
 ASIA/PACIFIC Seagate Singapore International Headquarters Pte. Ltd. 7000 Ang Mo Kio Avenue 5, Singapore 569877, 65-6485-3888
 EUROPE, MIDDLE EAST AND AFRICA Seagate Technology SAS 16-18, rue du Dôme, 92100 Boulogne-Billancourt, France, 33 1-4186 10 00

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FED_SEAG0015567**Metadata**

Attach Counts	0	ORIGINAL
Confidentiality	Confidential	USER
Custodian	Schweiss_Karl	ORIGINAL
Custodian Other	Burgeles_Mark;Schweiss_Karl	ORIGINAL
DATECREATED	9/26/2011	ORIGINAL
DATELASTMOD	9/26/2011	ORIGINAL
DOEXT	pdf	ORIGINAL
DOCTYPE	Adobe Portable Document Format	ORIGINAL
FED_BEGATTACH	FED_SEAG0015567	ORIGINAL
FED_ENDATTACH	FED_SEAG0015568	ORIGINAL
FileName	barracuda-ds1737-1-1111us_0B9OplTYqpH9a0JmZ1ZfRjBnclU.pdf	ORIGINAL
FILESIZE	466064	ORIGINAL
LastAccessDate	10/11/2016 12:00 AM	ORIGINAL
LastAccessedTime	1:47 AM	ORIGINAL
MD5 Hash	113C53F779437E06F8D4217D916C9B87	ORIGINAL
OrgFolder	\Schweiss_Karl\Karl_Schweiss_3\	ORIGINAL
RecordType	E-DOC	ORIGINAL
Relativity Image Count	2	ORIGINAL
Relativity Native Time Zone Offset	-8.00	ORIGINAL
TIMECREATED	12:42 PM	ORIGINAL
TimeLastMod	12:42 PM	ORIGINAL

EXHIBIT 3



Product Manual

Barracuda®

ST3000DM001
ST2500DM001
ST2000DM001
ST1500DM003
ST1000DM003
ST750DM003

Gen 14
100666115
Rev. A2
April 2011

Document Revision History

Revision	Date	Description of Change
Rev. A1	03/18/2011	Initial release.
Rev. A2	4/21/2011	Updated specifications.

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When referring to drive capacity, one gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity. In addition, some of the listed capacity is used for formatting and other functions, and thus will not be available for data storage. Seagate reserves the right to change, without notice, product offerings or specifications.

Contents

Seagate Technology Support Services	7
-------------------------------------------	---

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1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following Seagate Barracuda® model drives:

ST3000DM001	ST2000DM001	ST1000DM003
ST2500DM001	ST1500DM003	ST750DM003

These drives provide the following key features:

- 7200 RPM spindle speed.

- High instantaneous (burst) data-transfer rates (up to 600MB per second).

- Perpendicular recording technology provides the drives with increased areal density.

- State-of-the-art cache and on-the-fly error-correction algorithms.

- Native Command Queueing with command ordering to increase performance in demanding applications.

- Full-track multiple-sector transfer capability without local processor intervention.

- Seagate AcuTrac™ servo technology delivers dependable performance, even with hard drive track widths of only 75 nanometers.

- Seagate OptiCache™ technology boosts overall performance by as much as 10% over the previous generation.

- Seagate SmartAlign™ technology provides a simple, transparent migration to Advanced Format 4K sectors
- Quiet operation.

- Compliant with RoHS requirements in China and Europe.

- SeaTools diagnostic software performs a drive self-test that eliminates unnecessary drive returns.

- Support for S.M.A.R.T. drive monitoring and reporting.

- Supports latching SATA cables and connectors.

- Worldwide Name (WWN) capability uniquely identifies the drive.

1.1 About the Serial ATA interface

The Serial ATA interface provides several advantages over the traditional (parallel) ATA interface. The primary advantages include:

- Easy installation and configuration with true plug-and-play connectivity. It is not necessary to set any jumpers or other configuration options.

- Thinner and more flexible cabling for improved enclosure airflow and ease of installation.

- Scalability to higher performance levels.

In addition, Serial ATA makes the transition from parallel ATA easy by providing legacy software support. Serial ATA was designed to allow you to install a Serial ATA host adapter and Serial ATA disk drive in your current system and expect all of your existing applications to work as normal.

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The Serial ATA interface connects each disk drive in a point-to-point configuration with the Serial ATA host adapter. There is no master/slave relationship with Serial ATA devices like there is with parallel ATA. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. This essentially means both drives behave as if they are Device 0 (master) devices.

Note

The host adapter may, optionally, emulate a master/slave environment to host software where two devices on separate Serial ATA ports are represented to host software as a Device 0 (master) and Device 1 (slave) accessed at the same set of host bus addresses. A host adapter that emulates a master/slave environment manages two sets of shadow registers. This is not a typical Serial ATA environment.

The Serial ATA host adapter and drive share the function of emulating parallel ATA device behavior to provide backward compatibility with existing host systems and software. The Command and Control Block registers, PIO and DMA data transfers, resets, and interrupts are all emulated.

The Serial ATA host adapter contains a set of registers that shadow the contents of the traditional device registers, referred to as the Shadow Register Block. All Serial ATA devices behave like Device 0 devices. For additional information about how Serial ATA emulates parallel ATA, refer to the “Serial ATA International Organization: Serial ATA Revision 3.0”. The specification can be downloaded from www.sata-io.org.

2.0 Drive Specifications

Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, and nominal power. For convenience, the phrases *the drive* and *this drive* are used throughout this manual to indicate the following drive models:

ST3000DM001	ST2000DM001	ST1000DM003
ST2500DM001	ST1500DM003	ST750DM003

2.1 Specification summary tables

The specifications listed in the following tables are for quick reference. For details on specification measurement or definition, see the appropriate section of this manual.

Table 1 Drive specifications summary for 3TB and 2.5TB models

Drive Specification	ST3000DM001	ST2500DM001
Formatted capacity (512 bytes/sector)*	3000GB (3TB)	2500GB (2.5TB)
Guaranteed sectors	5,860,533,168	4,883,781,168
Heads	6	6
Disks	3	3
Bytes per sector	4096	4096
Default sectors per track	63	63
Default read/write heads	16	16
Default cylinders	16,383	16,383
Recording density (max)	1807kFCI	1807kFCI
Track density (avg)	352 ktracks/in	352 ktracks/in
Areal density (avg)	329 Gfc/in ²	329 Gfc/in ²
Spindle speed	7200 RPM	7200 RPM
Internal data transfer rate (max)	2147Mb/s	2147Mb/s
Sustained data transfer rate OD (max)	159MB/s	159MB/s
I/O data-transfer rate (max)	600MB/s	600MB/s
ATA data-transfer modes supported	PIO modes: 0 to 4 Multiword DMA modes: 0 to 2 Ultra DMA modes: 0 to 6	
Cache buffer	64MB	64MB
Height (max.)	26.1mm / 1.028 in	26.1mm / 1.028 in
Width (max.)	101.6mm / 4.0 in (± 0.010 in)	101.6mm / 4.0 in (± 0.010 in)
Length (max.)	146.99mm / 5.787 in	146.99mm / 5.787 in
Weight (typical)	622g / 1.371 lb	622g / 1.371 lb
Average latency	4.16ms	4.16ms
Power-on to ready (max.)	<10.0s	<10.0s
Standby to ready (max.)	<10.0s	<10.0s
Track-to-track seek time (typical)	<1.0ms read <1.2ms write	<1.0ms read <1.2ms write
Average seek, read (typical) Average seek, write (typical)	<8.5ms typical <9.5ms typical	<8.5ms typical <9.5ms typical

Drive Specifications

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Table 1 Drive specifications summary for 3TB and 2.5TB models (continued)

Drive Specification	ST3000DM001	ST2500DM001
Startup current (typical) 12V (peak)	2.5A	2.5A
Voltage tolerance (including noise)	5V +10% / -7.5% 12V +10% / -7.5%	5V +10% / -7.5% 12V +10% / -7.5%
Ambient temperature	0° to 70°C (operating) -40° to 70°C (non-operating)	0° to 70°C (operating) -40° to 70°C (non-operating)
Temperature gradient	20°C per hour max (operating) 30°C per hour max (non-operating)	20°C per hour max (operating) 30°C per hour max (non-operating)
Relative humidity	5% to 95% (operating) 5% to 95% (non-operating)	5% to 95% (operating) 5% to 95% (non-operating)
Relative humidity gradient (max.)	30% per hour	30% per hour
Wet bulb temperature (max.)	37.7°C max (operating) 40.0°C max (non-operating)	37.7°C max (operating) 40.0°C max (non-operating)
Altitude, operating	-304.8m to 3,048m (-1000 ft to 10,000+ ft)	-304.8m to 3,048m (-1000 ft to 10,000+ ft)
Altitude, non-operating (below mean sea level, max)	-304.8m to 12,192m (-1000 ft to 40,000+ ft)	-304.8m to 12,192m (-1000 ft to 40,000+ ft)
Operational Shock (max)	80 Gs at 2ms	80 Gs at 2ms
Non-Operational Shock (max)	300 Gs at 2ms	300 Gs at 2ms
Vibration, operating	2Hz to 22Hz: 0.25 Gs, Limited displacement 22Hz to 350Hz: 0.50 Gs 350Hz to 500Hz: 0.25 Gs	2Hz to 22Hz: 0.25 Gs, Limited displacement 22Hz to 350Hz: 0.50 Gs 350Hz to 500Hz: 0.25 Gs
Vibration, non-operating	5Hz to 22Hz: 3.0 Gs 22Hz to 350Hz: 3.0 Gs 350Hz to 500Hz: 3.0 Gs	5Hz to 22Hz: 3.0 Gs 22Hz to 350Hz: 3.0 Gs 350Hz to 500Hz: 3.0 Gs
Drive acoustics, sound power		
Idle**	2.4 bels (typical) 2.5 bels (max)	2.4 bels (typical) 2.5 bels (max)
Seek	2.6 bels (typical) 2.7 bels (max)	2.6 bels (typical) 2.7 bels (max)
Non-recoverable read errors	1 per 10 ¹⁴ bits read	1 per 10 ¹⁴ bits read
Annulized Failure Rate (AFR)	0.34%	0.34%
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: support.seagate.com/customer/warranty_validation.jsp From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.	
Load/Unload cycles (25°C, 50% rel. humidity)	300,000	300,000
Supports Hotplug operation per the Serial ATA Revision 2.5 specification	Yes	Yes

*One GB equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

**During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

Table 2 Drive specifications summary for 2TB and 1.5TB models

Drive Specification	ST2000DM001	ST1500DM003
Formatted capacity (512 bytes/sector)*	2000GB (2TB)	1500GB (1.5TB)
Guaranteed sectors	3,907,029,168	2,930,277,168
Heads	4	4
Disks	2	2
Bytes per sector	4096	4096
Default sectors per track	63	63
Default read/write heads	16	16
Default cylinders	16,383	16,383
Recording density (max.)	1807kFCI	1807kFCI
Track density (avg.)	352 ktracks/in	352 ktracks/in
Areal density (avg.)	625 Gfc/in ²	625 Gfc/in ²
Spindle speed	7200 RPM	7200 RPM
Internal data transfer rate (max)	2147Mb/s	2147Mb/s
Sustained data transfer rate OD (max)	159MB/s	159MB/s
I/O data-transfer rate (max.)	600MB/s	600MB/s
ATA data-transfer modes supported	PIO modes: 0 to 4 Multiword DMA modes: 0 to 2 Ultra DMA modes: 0 to 6	PIO modes: 0 to 4 Multiword DMA modes: 0 to 2 Ultra DMA modes: 0 to 6
Cache buffer	64MB	64MB
Height (max.)	26.1mm / 1.028 in	26.1mm / 1.028 in
Width (max.)	101.6mm / 4.0 in (± 0.010 in)	101.6mm / 4.0 in (± 0.010 in)
Length (max.)	146.99mm / 5.787 in	146.99mm / 5.787 in
Weight (typical)	415g / 0.915 lb	415g / 0.915 lb
Average latency	4.16ms	4.16ms
Power-on to ready (max)	<8.5s	<8.5s
Standby to ready (max)	<8.5s	<8.5s
Track-to-track seek time (typical)	<1.0ms read; <1.2ms write	<1.0ms read; <1.2ms write
Average seek, read (typical)	<8.5ms	<8.5ms
Average seek, write (typical)	<9.5ms	<9.5ms
Startup current (typical) 12V (peak)	2.0A	2.0A
Voltage tolerance (including noise)	5V +10% / -7.5% 12V +10% / -7.5%	5V +10% / -7.5% 12V +10% / -7.5%
Ambient temperature	0° to 60°C (operating) -40° to 70°C (non-operating)	0° to 60°C (operating) -40° to 70°C (non-operating)
Temperature gradient	20°C per hour max (operating) 30°C per hour max (non-operating)	20°C per hour max (operating) 30°C per hour max (non-operating)
Relative humidity	5% to 95% (operating) 5% to 95% (non-operating)	5% to 95% (operating) 5% to 95% (non-operating)
Relative humidity gradient (max)	30% per hour	30% per hour
Wet bulb temperature (max)	37.7°C (operating) 40.0°C (non-operating)	37.7°C (operating) 40.0°C (non-operating)
Altitude, operating	-304.8m to 3,048m (-1000 ft to 10,000+ ft)	-304.8m to 3,048m (-1000 ft to 10,000+ ft)
Altitude, non-operating (below mean sea level, max)	-304.8m to 12,192m (-1000 ft to 40,000+ ft)	-304.8m to 12,192m (-1000 ft to 40,000+ ft)
Operational Shock (max)	80 Gs at 2ms	80 Gs at 2ms
Non-Operational Shock (max)	350 Gs at 2ms	350 Gs at 2ms

Drive Specifications

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Table 2 Drive specifications summary for 2TB and 1.5TB models (continued)

Drive Specification	ST2000DM001	ST1500DM003
Vibration, operating	2Hz to 22Hz: 0.25 Gs, Limited displacement 22Hz to 350Hz: 0.50 Gs 350Hz to 500Hz: 0.25 Gs	2Hz to 22Hz: 0.25 Gs, Limited displacement 22Hz to 350Hz: 0.50 Gs 350Hz to 500Hz: 0.25 Gs
Vibration, non-operating	5Hz to 22Hz: 3.0 Gs 22Hz to 350Hz: 3.0 Gs 350Hz to 500Hz: 3.0 Gs	5Hz to 22Hz: 3.0 Gs 22Hz to 350Hz: 3.0 Gs 350Hz to 500Hz: 3.0 Gs
Drive acoustics, sound power		
Idle**	2.3 bels (typical) 2.4 bels (max)	2.3 bels (typical) 2.4 bels (max)
Seek	2.4 bels (typical) 2.5 bels (max)	2.4 bels (typical) 2.5 bels (max)
Non-recoverable read errors	1 per 10 ¹⁴ bits read	1 per 10 ¹⁴ bits read
Annulized Failure Rate (AFR)	0.34%	0.34%
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: support.seagate.com/customer/warranty_validation.jsp From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.	
Load/Unload cycles (25°C, 50% rel. humidity)	300,000	300,000
Supports Hotplug operation per the Serial ATA Revision 2.5 specification	Yes	Yes

*One GB equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

**During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

Table 3 Drive specifications summary for 1TB and 750GB models

Drive Specification	ST1000DM003	ST750DM003
Formatted capacity (512 bytes/sector)*	1000GB (1TB)	750GB
Guaranteed sectors	1,953,525,168	1,465,149,168
Heads	2	2
Disks	1	1
Bytes per sector	4096	4096
Default sectors per track	63	63
Default read/write heads	16	16
Default cylinders	16,383	16,383
Recording density (max.)	1807kFCI	1807kFCI
Track density (avg.)	352 ktracks/in	352 ktracks/in
Areal density (avg.)	625 Gfc/in ²	625 Gfc/in ²
Spindle speed	7200 RPM	7200 RPM
Internal data transfer rate (max.)	2147 Mb/s	2147 Mb/s
Sustained data transfer rate OD (max.)	159 MB/s	159 MB/s
I/O data-transfer rate	600 MB/s	600 MB/s
ATA data-transfer modes supported	PIO modes: 0 to 4 Multiword DMA modes: 0 to 2 Ultra DMA modes: 0 to 6	PIO modes: 0 to 4 Multiword DMA modes: 0 to 2 Ultra DMA modes: 0 to 6
Cache buffer	64MB	64MB
Height (max.)	20.17mm / 0.7825 in	19.98mm / 0.787 in
Width (max.)	101.6mm / 4.0 in (± 0.010 in)	101.6mm / 4.0 in (± 0.010 in)
Length (max.)	146.99mm / 5.787 in	146.99mm / 5.787 in
Weight (typical)	415g / 0.915 lb	415g / 0.915 lb

Table 3 Drive specifications summary for 1TB and 750GB models (continued)

Drive Specification	ST1000DM003	ST750DM003
Average latency	4.16ms	4.16ms
Power-on to ready (max.)	<8.5s	<8.5s
Standby to ready (max.)	<8.5s	<8.5s
Track-to-track seek time (typical)	<1.0ms (read) <1.2ms (write)	<1.0ms (read) <1.2ms (write)
Average seek, read (typical)	<8.5ms (read)	<8.5ms (read)
Average seek, write (typical)	<9.5ms (write)	<9.5ms (write)
Startup current (typical) 12V (peak)	2.0A	2.0A
Voltage tolerance (including noise)	5V +10% / -7.5% 12V +10% / -7.5%	5V +10% / -7.5% 12V +10% / -7.5%
Ambient temperature	0° to 60°C (operating) -40° to 70°C (non-operating)	0° to 60°C (operating) -40° to 70°C (non-operating)
Temperature gradient (max.)	20°C per hour (operating) 30°C per hour (non-operating)	20°C per hour (operating) 30°C per hour (non-operating)
Relative humidity	5% to 95% (operating) 5% to 95% (non-operating)	5% to 95% (operating) 5% to 95% (non-operating)
Relative humidity gradient (max.)	30% per hour	30% per hour
Wet bulb temperature	37.7°C max (operating) 40.0°C max (non-operating)	37.7°C max (operating) 40.0°C max (non-operating)
Altitude, operating	-60.96m to 3,048m (-1000 ft to 10,000+ ft)	-60.96m to 3,048m (-1000 ft to 10,000+ ft)
Altitude, non-operating (below mean sea level, max.)	-60.96m to 12,192m (-1000 ft to 40,000+ ft)	-60.96m to 12,192m (-1000 ft to 40,000+ ft)
Operational Shock (max.)	80 Gs at 2ms	80 Gs at 2ms
Non-Operational Shock (max.)	350 Gs at 2ms	350 Gs at 2ms
Vibration, operating	2Hz to 22Hz: 0.25 Gs, Limited displacement 22Hz to 350Hz: 0.50 Gs 350Hz to 500Hz: 0.25 Gs	2Hz to 22Hz: 0.25 Gs, Limited displacement 22Hz to 350Hz: 0.50 Gs 350Hz to 500Hz: 0.25 Gs
Vibration, non-operating	5Hz to 22Hz: 3.0 Gs 22Hz to 350Hz: 3.0 Gs 350Hz to 500Hz: 3.0 Gs	5Hz to 22Hz: 3.0 Gs 22Hz to 350Hz: 3.0 Gs 350Hz to 500Hz: 3.0 Gs
Drive acoustics, sound power		
Idle**	2.2 bels (typical) 2.3 bels (max)	2.2 bels (typical) 2.3 bels (max)
Seek	2.3 bels (typical) 2.4 bels (max)	2.3 bels (typical) 2.4 bels (max)
Non-recoverable read errors	1 per 10 ¹⁴ bits read	1 per 10 ¹⁴ bits read
Annulized Failure Rate (AFR)	0.34%	0.34%
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: support.seagate.com/customer/warranty_validation.jsp . From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.	
Load/Unload cycles (25°C, 50% rel. humidity)	300,000	300,000
Supports Hotplug operation per the Serial ATA Revision 2.5 specification	Yes	Yes

*One GB equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

**During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

2.2 Formatted capacity

Model	Formatted capacity*	Guaranteed sectors	Bytes per sector
ST3000DM001	3000GB	5,860,533,168	4096
ST2500DM001	2500GB	4,883,781,168	
ST2000DM001	2000GB	3,907,029,168	
ST1500DM003	1500GB	2,930,277,168	
ST1000DM003	1000GB	1,953,525,168	
ST750DM003	750GB	1,465,149,168	

*One GB equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

2.2.1 LBA mode

When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to $n-1$, where n is the number of guaranteed sectors as defined above.

See Section 4.3.1, "Identify Device command" (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137GB.

2.3 Default logical geometry

Cylinders	Read/write heads	Sectors per track
16,383	16	63

LBA mode

When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to $n-1$, where n is the number of guaranteed sectors as defined above.

2.4 Recording and interface technology

Interface	Serial ATA (SATA)
Recording method	Perpendicular
Recording density (kFCI)	1807
Track density (ktracks/inch avg)	352
Areal density (Gfc/in ² avg)	625
Spindle speed (RPM)	7200 ± 0.2%
Internal data transfer rate (Mb/s max)	2147
Sustained data transfer rate (MB/s max)	159
I/O data-transfer rate (MB/s max)	600

2.5 Physical characteristics

Maximum height	
3TB, 2.5TB, 2TB, 1.5TB	26.1mm / 1.028 in
1TB	20.17mm / 0.7825 in
750GB	19.98mm / 0.787 in
Maximum width (all models)	101.6mm / 4.0 in (± 0.010 in)
Maximum length (all models)	146.99mm / 5.787 in
Typical weight	
3TB, 2.5TB	622g / 1.371 lb
2TB, 1.5TB, 1TB, 750GB	415g/0.915 lb
Cache buffer	64MB (64,768kb)

2.6 Seek time

Seek measurements are taken with nominal power at 25°C ambient temperature. All times are measured using drive diagnostics. The specifications in the table below are defined as follows:

Track-to-track seek time is an average of all possible single-track seeks in both directions.

Average seek time is a true statistical random average of at least 5,000 measurements of seeks between random tracks, less overhead.

Typical seek times (ms)	Read	Write
Track-to-track	1.0	1.2
Average	8.5	9.5
Average latency	4.16	

Note

These drives are designed to consistently meet the seek times represented in this manual. Physical seeks, regardless of mode (such as track-to-track and average), are expected to meet the noted values. However, due to the manner in which these drives are formatted, benchmark tests that include command overhead or measure logical seeks may produce results that vary from these specifications.

2.7 Start/stop times

	3-disk models	2-disk models	1-disk models
Power-on to Ready (typ / max sec)	<10	<8.5	<6
Standby to Ready (typ / max sec)	<10	<8.5	<6
Ready to spindle stop (typ / max sec)	<11	10	<10

2.8 Power specifications

The drive receives DC power (+5V or +12V) through a native SATA power connector. Refer to Figure 1 on page 30 on page 30.

2.8.1 Power consumption

Power requirements for the drives are listed in Table 5 on page 20 and Table 6 on page 20. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V and 12.0V input voltage at 25°C ambient temperature.

Spinup power

Spinup power is measured from the time of power-on to the time that the drive spindle reaches operating speed.

Read/write power and current

Read/write power is measured with the heads on track, based on a 16-sector write followed by a 32-ms delay, then a 16-sector read followed by a 32-ms delay.

Operating power and current

Operating power is measured using 40 percent random seeks, 40 percent read/write mode (1 write for each 10 reads) and 20 percent drive idle mode.

Idle mode power

Idle mode power is measured with the drive up to speed, with servo electronics active and with the heads in a random track location.

Standby mode

During Standby mode, the drive accepts commands, but the drive is not spinning, and the servo and read/write electronics are in power-down mode.

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Table 4 DC power requirements (3-disk)

Power dissipation (3-disk values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V typ amps
Spinup	—	—	2.5 (peak)
Idle* †	6.4	—	—
Idle* † (with offline activity)	6.3	—	—
Operating	7.38	—	—
Standby	0.74	—	—
Sleep	0.74	—	—

Table 5 DC power requirements (2/3-disk)

Power dissipation (2-disk values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V typ amps
Spinup	—	—	2.0 (peak)
Idle* †	5.9	—	—
Idle* † (with offline activity)	6.1	—	—
Operating	6.80	—	—
Standby	0.74	—	—
Sleep	0.74	—	—

Table 6 DC power requirements (1-disk)

Power dissipation (1-disk values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V typ amps
Spinup	—	—	2.0 (peak)
Idle* †	4.8	—	—
Idle* † (with offline activity)	5.0	—	—
Operating	6.19	—	—
Standby	0.74	—	—
Sleep	0.74	—	—

*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

†5W IDLE with DIPLM Enabled

2.8.2 Conducted noise

Input noise ripple is measured at the host system power supply across an equivalent 80-ohm resistive load on the +12 volt line or an equivalent 15-ohm resistive load on the +5 volt line.

Using 12-volt power, the drive is expected to operate with a maximum of 120 mV peak-to-peak square-wave injected noise at up to 10MHz.

Using 5-volt power, the drive is expected to operate with a maximum of 100 mV peak-to-peak square-wave injected noise at up to 10MHz.

Note	Equivalent resistance is calculated by dividing the nominal voltage by the typical RMS read/write current.
-------------	------------------------------------------------------------------------------------------------------------

2.8.3 Voltage tolerance

Voltage tolerance (including noise):

5V +10% / -7.5%

12V +10% / -7.5%

2.8.4 Power-management modes

The drive provides programmable power management to provide greater energy efficiency. In most systems, you can control power management through the system setup program. The drive features the following power-management modes:

Power modes	Heads	Spindle	Buffer
Active	Tracking	Rotating	Enabled
Idle	Tracking	Rotating	Enabled
Standby	Parked	Stopped	Enabled
Sleep	Parked	Stopped	Disabled

Active mode

The drive is in Active mode during the read/write and seek operations.

Idle mode

The buffer remains enabled, and the drive accepts all commands and returns to Active mode any time disk access is necessary.

Standby mode

The drive enters Standby mode when the host sends a Standby Immediate command. If the host has set the standby timer, the drive can also enter Standby mode automatically after the drive has been inactive for a specifiable length of time. The standby timer delay is established using a Standby or Idle command. In Standby mode, the drive buffer is enabled, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disk access is necessary.

Sleep mode

The drive enters Sleep mode after receiving a Sleep command from the host. In Sleep mode, the drive buffer is disabled, the heads are parked and the spindle is at rest. The drive leaves Sleep mode after it receives a Hard Reset or Soft Reset from the host. After receiving a reset, the drive exits Sleep mode and enters Standby mode with all current translation parameters intact.

Idle and Standby timers

Each time the drive performs an Active function (read, write or seek), the standby timer is reinitialized and begins counting down from its specified delay times to zero. If the standby timer reaches zero before any drive activity is required, the drive makes a transition to Standby mode. In both Idle and Standby mode, the drive accepts all commands and returns to Active mode when disk access is necessary.

2.9 Environmental specifications

2.9.1 Ambient temperature

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Actual drive case temperature should not exceed 69°C (156°F) within the operating ambient conditions.

Operating:	0° to 60°C (32° to 140°F)
Non-operating:	–40° to 70°C (–40° to 158°F)

2.9.2 Temperature gradient

Operating:	20°C per hour (68°F per hour max), without condensation
Non-operating:	30°C per hour (86°F per hour max)

2.9.3 Humidity

2.9.3.1 Relative humidity

Operating:	5% to 95% non-condensing (30% per hour max)
Nonoperating:	5% to 95% non-condensing (30% per hour max)

2.9.3.2 Wet bulb temperature

Operating:	37.7°C (99.9°F max)
Non-operating:	40°C (104°F max)

2.9.4 Altitude

Operating:	–304.8 m to 3,048 m (–1000 ft. to 10,000+ ft.)
Non-operating:	–304.8 m to 12,192 m (–1000 ft. to 40,000+ ft.)

2.9.5 Shock

All shock specifications assume that the drive is mounted securely with the input shock applied at the drive mounting screws. Shock may be applied in the X, Y or Z axis.

2.9.5.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 80 Gs based on half-sine shock pulses of 2 ms during read operations. Shocks should not be repeated more than two times per second.

2.9.5.2 Non-operating shock

3TB and 2.5TB models

The non-operating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 300 Gs based on a non-repetitive half-sine shock pulse of 2 ms duration.

2TB, 1.5TB, 1TB and 750GB models

The non-operating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 350 Gs based on a non-repetitive half-sine shock pulse of 2-ms duration.

Vibration

All vibration specifications assume that the drive is mounted securely with the input vibration applied at the drive mounting screws. Vibration may be applied in the X, Y or Z axis.

2.9.5.3 Operating vibration

The maximum vibration levels that the drive may experience while meeting the performance standards specified in this document are specified below.

2Hz to 22Hz	0.25 Gs (Limited displacement)
22Hz to 350Hz	0.50 Gs
350Hz to 500Hz	0.25 Gs

Non-operating vibration

The maximum non-operating vibration levels that the drive may experience without incurring physical damage or degradation in performance when subsequently put into operation are specified below.

5Hz to 22Hz	3.0 Gs (Limited displacement)
22Hz to 350Hz	3.0 Gs
350Hz to 500Hz	3.0 Gs

2.10 Acoustics

Drive acoustics are measured as overall A-weighted acoustic sound power levels (no pure tones). All measurements are consistent with ISO document 7779. Sound power measurements are taken under essentially free-field conditions over a reflecting plane. For all tests, the drive is oriented with the cover facing upward.

Note

For seek mode tests, the drive is placed in seek mode only. The number of seeks per second is defined by the following equation:

(Number of seeks per second = $0.4 / (\text{average latency} + \text{average access time})$)

Table 7 Fluid Dynamic Bearing (FDB) motor acoustics

	Idle*	Seek
3 Disks, 3TB and 2.5GB ST3000DM001,ST2500DM001)	2.4 bels (typical) 2.5 bels (max)	2.6 bels (typical) 2.7 bels (max)
2 Disks, 2TB and 1.5TB models (ST2000DM001,ST1500DM003)	2.3 bels (typical) 2.4 bels (max)	2.5 bels (typical) 2.6 bels (max)
1 Disk, 1TB and 750GB models (ST1000DM003,ST750DM003)	2.2 bels (typical) 2.3 bels (max)	2.4 bels (typical) 2.5 bels (max)

*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

2.10.1 Test for Prominent Discrete Tones (PDTs)

Seagate follows the ECMA-74 standards for measurement and identification of PDTs. An exception to this process is the use of the absolute threshold of hearing. Seagate uses this threshold curve (originated in ISO 389-7) to discern tone audibility and to compensate for the inaudible components of sound prior to computation of tone ratios according to Annex D of the ECMA-74 standards.

2.11 Electromagnetic immunity

When properly installed in a representative host system, the drive operates without errors or degradation in performance when subjected to the radio frequency (RF) environments defined in the following **Table 8**:

Table 8 Radio frequency environments

Test	Description	Performance level	Reference standard
Electrostatic discharge	Contact, HCP, VCP: ± 4 kV; Air: ± 8 kV	B	EN61000-4-2: 95
Radiated RF immunity	80MHz to 1,000MHz, 3 V/m, 80% AM with 1kHz sine 900MHz, 3 V/m, 50% pulse modulation @ 200Hz	A	EN61000-4-3: 96 ENV50204: 95
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN61000-4-5: 95
Conducted RF immunity	150kHz to 80MHz, 3 Vrms, 80% AM with 1kHz sine	A	EN61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN61000-4-11: 94

2.12 Reliability

The product shall achieve an Annualized Failure Rate (AFR) of 0.34% (MTBF of 0.75 million hours) when operated in an environment of ambient air temperatures of 25°C. Operation at temperatures outside the specifications in Section 2.9 may increase the product AFR (decrease MTBF). AFR and MTBF are population statistics that are not relevant to individual units.

AFR and MTBF specifications are based on the following assumptions for desktop personal computer environments:

2400 power-on-hours per year.

10,000 average motor start/stop cycles per year.

Operations at nominal voltages.

Temperatures outside the specifications in Section 2.9 may reduce the product reliability.

Normal I/O duty cycle for desktop personal computers. Operation at excessive I/O duty cycle may degrade product reliability.

The desktop personal computer environment of power-on-hours, temperature, and I/O duty cycle affect the product AFR and MTBF. The AFR and MTBF will be degraded if used in an enterprise application.

Nonrecoverable read errors	1 per 10^{14} bits read, max
Annualized Failure Rate (AFR)	0.34% (nominal power, 25°C ambient temperature)
Load/Unload cycles (25°C, 50% rel. humidity)	300,000
Preventive maintenance	None required.

2.13 Warranty

To determine the warranty for a specific drive, use a web browser to access the following web page:
support.seagate.com/customer/warranty_validation.jsp

From this page, click on the “Verify Your Warranty” link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive.

2.14 Agency certification

2.14.1 Safety certification

These products are certified to meet the requirements of UL60950-1, CSA60950-1 and EN60950 and so marked as to the certify agency.

2.14.2 Electromagnetic compatibility

Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2004/108/EC) as put into place 20 July 2007. Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55022, Class B and the immunity levels are defined by EN 55024.

Drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports. Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products.

Korean RRL

If these drives have the Korean Communications Commission (KCC) logo, they comply with paragraph 1 of Article 11 of the Electromagnetic Compatibility control Regulation and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Communications Commission, Republic of Korea.

These drives have been tested and comply with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class B products. Drives are tested in a representative, end-user system by a Korean-recognized lab.

Family name: Barracuda 7200.14

Certificate number: in progress

Australian C-Tick (N176)

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZ CISPR22 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

2.14.3 FCC verification

These drives are intended to be contained solely within a personal computer or similar enclosure (not attached as an external device). As such, each drive is considered to be a subassembly even when it is individually marketed to the customer. As a subassembly, no Federal Communications Commission verification or certification of the device is required.

Seagate has tested this device in enclosures as described above to ensure that the total assembly (enclosure, disk drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J, Part 15 of the FCC rules. Operation with non-certified assemblies is likely to result in interference to radio and television reception.

Radio and television interference. This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception.

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This equipment is designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television, which can be determined by turning the equipment on and off, you are encouraged to try one or more of the following corrective measures:

- Reorient the receiving antenna.
- Move the device to one side or the other of the radio or TV.
- Move the device farther away from the radio or TV.
- Plug the computer into a different outlet so that the receiver and computer are on different branch outlets.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems*. This booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

2.15 Environmental protection

Seagate designs its products to meet environmental protection requirements worldwide, including regulations restricting certain chemical substances.

2.15.1 European Union Restriction of Hazardous Substances (RoHS) Directive

The European Union Restriction of Hazardous Substances (RoHS) Directive, restricts the presence of chemical substances, including Lead, Cadmium, Mercury, Hexavalent Chromium, PBB and PBDE, in electronic products, effective July 2006. This drive is manufactured with components and materials that comply with the RoHS Directive.

2.15.2 China Restriction of Hazardous Substances (RoHS) Directive 中国限制危险物品的指令

This product has an Environmental Protection Use Period (EPUP) of 20 years. The following table contains information mandated by China's "Marking Requirements for Control of Pollution Caused by Electronic Information Products" Standard.



该产品具有20年的环境保护使用周期（EPUP）。下表包含了中国“电子产品所导致的污染的控制的记号要求”所指定的信息。

Name of Parts 部件名称	Toxic or Hazardous Substances or Elements 有毒有害物质或元素					
	Lead 铅 (Pb)	Mercury 汞 (Hg)	Cadmium 镉 (Cd)	Hexavalent Chromium 六价铬 (Cr6+)	Polybrominated Diphenyl 多溴联苯 (PBB)	Polybrominated Diphenyl Ether 多溴二苯醚 (PBDE)
PCBA	X	O	O	O	O	O
HDA	X	O	O	O	O	O

"O" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is lower than the threshold defined by the China RoHS MCV Standard.

“O”表示该部件（于同类物品程度上）所含的危险和有毒物质低于中国RoHS MCV标准所定义的门槛值。

"X" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is over the threshold defined by the China RoHS MCV Standard.

“X”表示该部件（于同类物品程度上）所含的危险和有毒物质超出中国RoHS MCV标准所定义的门槛值。

2.16 Corrosive environment

Seagate electronic drive components pass accelerated corrosion testing equivalent to 10 years exposure to light industrial environments containing sulfurous gases, chlorine and nitric oxide, classes G and H per ASTM B845. However, this accelerated testing cannot duplicate every potential application environment. Users should use caution exposing any electronic components to uncontrolled chemical pollutants and corrosive chemicals as electronic drive component reliability can be affected by the installation environment. The silver, copper, nickel and gold films used in Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or exposed to an ambient relative humidity greater than 95%. Materials used in cabinet fabrication, such as vulcanized rubber, that can outgas corrosive compounds should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.

3.0 Configuring and Mounting the Drive

This section contains the specifications and instructions for configuring and mounting the drive.

3.1 Handling and static-discharge precautions

After unpacking, and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

Caution

- Before handling the drive, put on a grounded wrist strap, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.
- Handle the drive by its edges or frame *only*.
- The drive is extremely fragile—handle it with care. Do not press down on the drive top cover.
- Always rest the drive on a padded, antistatic surface until you mount it in the computer.
- Do not touch the connector pins or the printed circuit board.
- Do not remove the factory-installed labels from the drive or cover them with additional labels. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive. Other labels are used to seal out dirt and contamination.

3.2 Configuring the drive

Each drive on the Serial ATA interface connects point-to-point with the Serial ATA host adapter. There is no master/slave relationship because each drive is considered a master in a point-to-point relationship. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. Both drives behave as if they are Device 0 (master) devices.

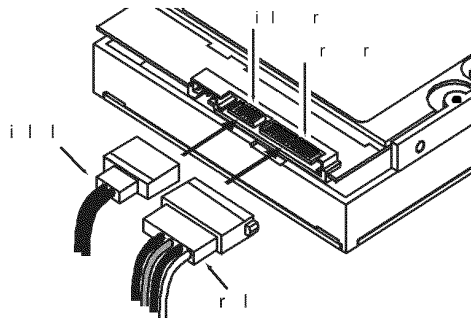
Serial ATA drives are designed for easy installation. It is usually not necessary to set any jumpers on the drive for proper operation; however, if you connect the drive and receive a “drive not detected” error, your SATA-equipped motherboard or host adapter may use a chipset that does not support SATA speed autonegotiation.

3.3 Serial ATA cables and connectors

The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 inches). See [Table 9](#) for connector pin definitions. Either end of the SATA signal cable can be attached to the drive or host.

For direct backplane connection, the drive connectors are inserted directly into the host receptacle. The drive and the host receptacle incorporate features that enable the direct connection to be hot pluggable and blind mateable.

For installations which require cables, you can connect the drive as illustrated in [Figure 1](#).

Figure 1 Attaching SATA cabling

Each cable is keyed to ensure correct orientation. Barracuda drives support latching SATA connectors.

3.4 Drive mounting

You can mount the drive in any orientation using four screws in the side-mounting holes or four screws in the bottom-mounting holes. See **Figure 2** and **Figure 3** for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 inches (0.76mm) around the entire perimeter of the drive for cooling.
- Use only 6-32 UNC mounting screws.
- The screws should be inserted no more than 0.150 inch (3.81mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: 6 inch-lb).

Figure 2 Mounting dimensions (3/2-disk: 3TB, 2.5TB, 2TB, 1.5TB models)

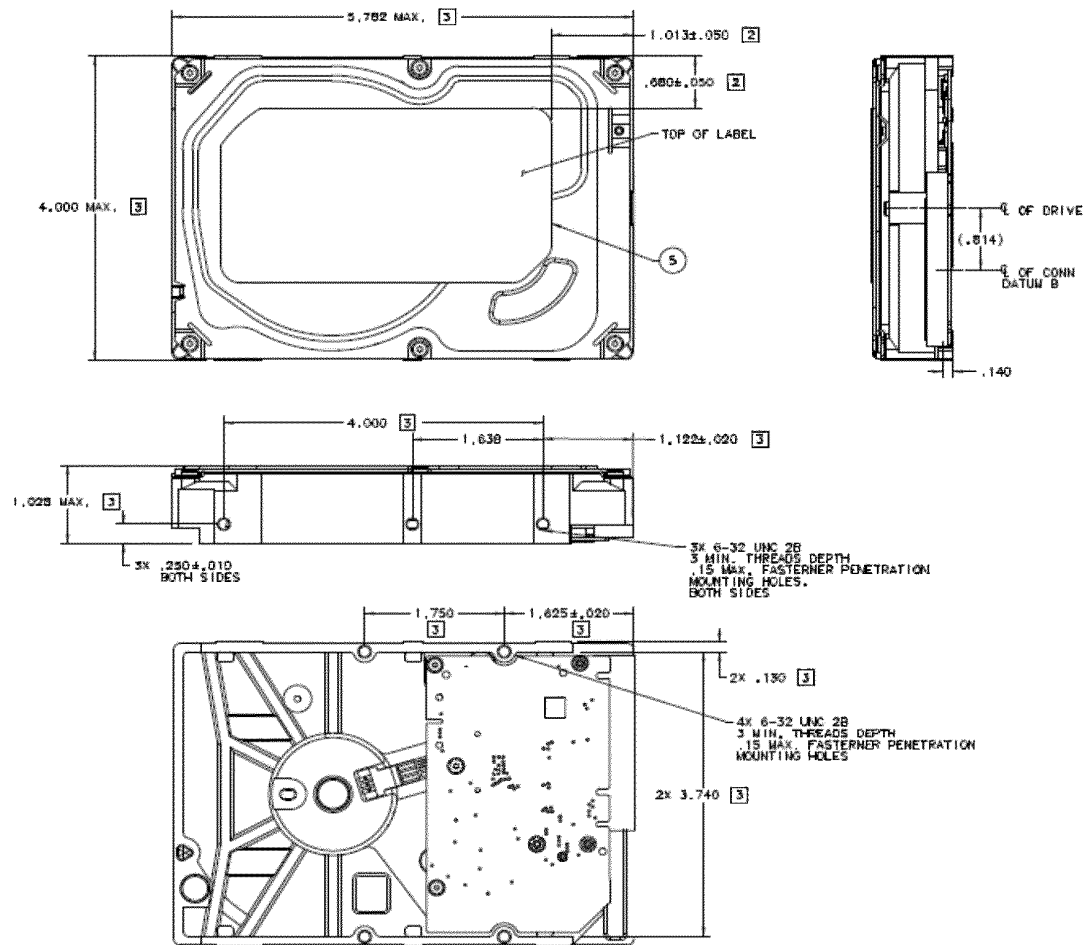
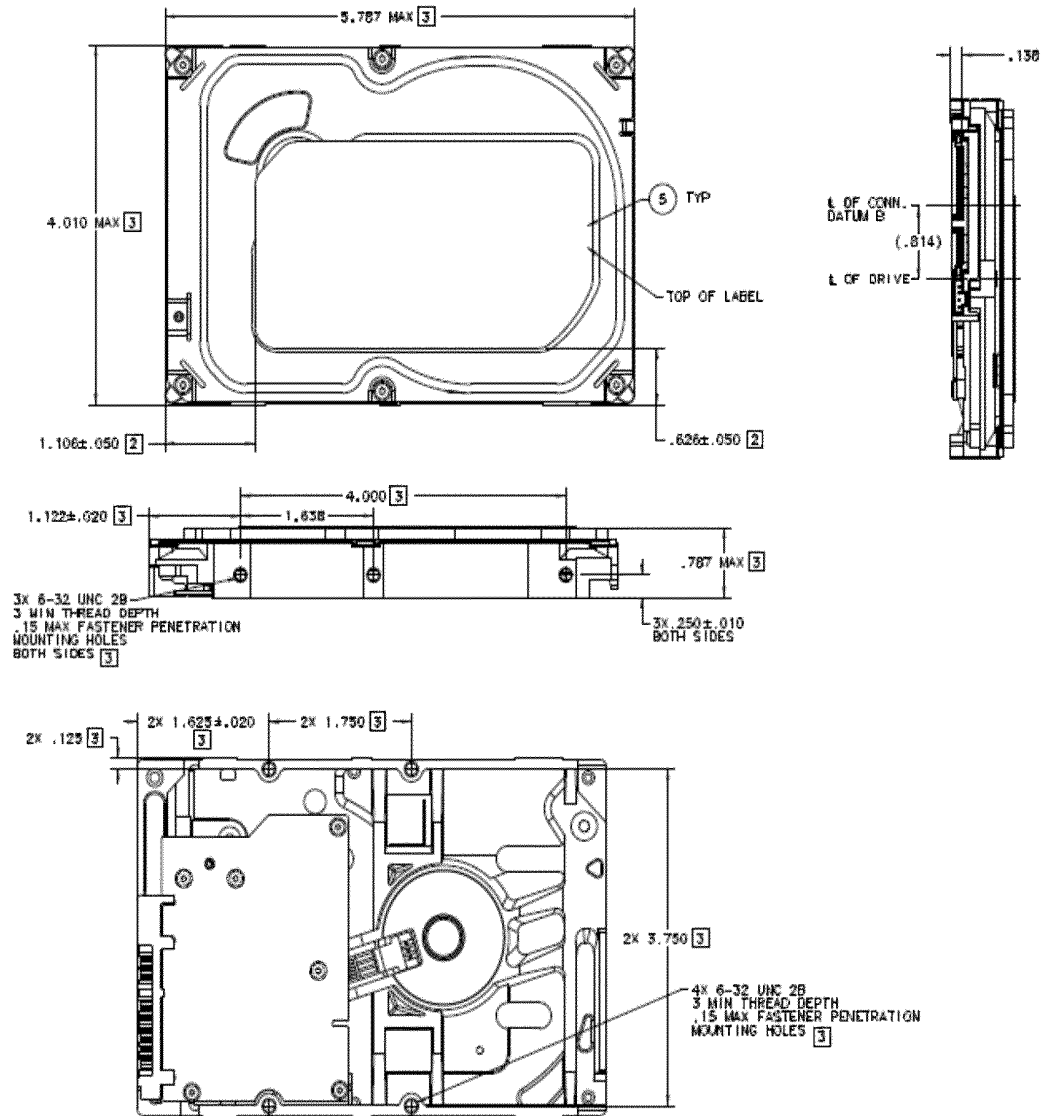


Figure 3 Mounting dimensions (1-Disk: 1TB and 750GB models)



4.0 Serial ATA (SATA) Interface

These drives use the industry-standard Serial ATA interface that supports FIS data transfers. It supports ATA programmed input/output (PIO) modes 0 to 4; multiword DMA modes 0 to 2, and Ultra DMA modes 0 to 6.

For detailed information about the Serial ATA interface, refer to the “Serial ATA: High Speed Serialized AT Attachment” specification.

4.1 Hot-Plug compatibility

Barracuda drives incorporate connectors which enable you to hot plug these drives in accordance with the Serial ATA Revision 2.5 specification. This specification can be downloaded from www.serialata.org.

4.2 Serial ATA device plug connector pin definitions

Table 9 summarizes the signals on the Serial ATA interface and power connectors.

Table 9 Serial ATA connector pin definitions

Segment	Pin	Function	Definition
Signal	S1	Ground	2nd mate
	S2	A+	Differential signal pair A from Phy
	S3	A-	
	S4	Ground	2nd mate
	S5	B-	Differential signal pair B from Phy
	S6	B+	
	S7	Ground	2nd mate
Key and spacing separate signal and power segments			

Table 9 Serial ATA connector pin definitions

Segment	Pin	Function	Definition
Power	P1	V ₃₃	3.3V power
	P2	V ₃₃	3.3V power
	P3	V ₃₃	3.3V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V ₅	5V power, pre-charge, 2nd mate
	P8	V ₅	5V power
	P9	V ₅	5V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive does not use deferred spin
	P12	Ground	1st mate.
	P13	V ₁₂	12V power, pre-charge, 2nd mate
	P14	V ₁₂	12V power
	P15	V ₁₂	12V power

Notes

- All pins are in a single row, with a 1.27 mm (0.050") pitch.
- The comments on the mating sequence apply to the case of backplane blindmate connector only. In this case, the mating sequences are:
 - the ground pins P4 and P12.
 - the pre-charge power pins and the other ground pins.
 - the signal pins and the rest of the power pins.
- There are three power pins for each voltage. One pin from each voltage is used for pre-charge when installed in a blind-mate backplane configuration.
 - All used voltage pins (V_x) must be terminated.

4.3 Supported ATA commands

The following table lists Serial ATA standard commands that the drive supports.

For a detailed description of the ATA commands, refer to the Serial ATA International Organization: Serial ATA Revision 2.6 (<http://www.sata-io.org>).

See "S.M.A.R.T. commands" on page 42 for details and subcommands used in the S.M.A.R.T. implementation.

Command name	Command code (in hex)
Check Power Mode	E5 _H
Device Configuration Freeze Lock	B1 _H / C1 _H
Device Configuration Identify	B1 _H / C2 _H
Device Configuration Restore	B1 _H / C0 _H
Device Configuration Set	B1 _H / C3 _H

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Command name	Command code (in hex)
Device Reset	08 _H
Download Microcode	92 _H
Execute Device Diagnostics	90 _H
Flush Cache	E7 _H
Flush Cache Extended	EA _H
Format Track	50 _H
Identify Device	EC _H
Idle	E3 _H
Idle Immediate	E1 _H
Initialize Device Parameters	91 _H
Read Buffer	E4 _H
Read DMA	C8 _H
Read DMA Extended	25 _H
Read DMA Without Retries	C9 _H
Read Log Ext	2F _H
Read Multiple	C4 _H
Read Multiple Extended	29 _H
Read Native Max Address	F8 _H
Read Native Max Address Extended	27 _H
Read Sectors	20 _H
Read Sectors Extended	24 _H
Read Sectors Without Retries	21 _H
Read Verify Sectors	40 _H
Read Verify Sectors Extended	42 _H
Read Verify Sectors Without Retries	41 _H
Recalibrate	10 _H
Security Disable Password	F6 _H
Security Erase Prepare	F3 _H
Security Erase Unit	F4 _H
Security Freeze	F5 _H
Security Set Password	F1 _H
Security Unlock	F2 _H
Seek	70 _H
Set Features	EF _H

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Command name	Command code (in hex)
Set Max Address Note: Individual Set Max Address commands are identified by the value placed in the Set Max Features register as defined to the right.	F9 _H Address: 00 _H Password: 01 _H Lock: 02 _H Unlock: 03 _H Freeze Lock: 04 _H
Set Max Address Extended	37 _H
Set Multiple Mode	C6 _H
Sleep	E6 _H
S.M.A.R.T. Disable Operations	B0 _H / D9 _H
S.M.A.R.T. Enable/Disable Autosave	B0 _H / D2 _H
S.M.A.R.T. Enable Operations	B0 _H / D8 _H
S.M.A.R.T. Execute Offline	B0 _H / D4 _H
S.M.A.R.T. Read Attribute Thresholds	B0 _H / D1 _H
S.M.A.R.T. Read Data	B0 _H / D0 _H
S.M.A.R.T. Read Log Sector	B0 _H / D5 _H
S.M.A.R.T. Return Status	B0 _H / DA _H
S.M.A.R.T. Save Attribute Values	B0 _H / D3 _H
S.M.A.R.T. Write Log Sector	B0 _H / D6 _H
Standby	E2 _H
Standby Immediate	E0 _H
Write Buffer	E8 _H
Write DMA	CA _H
Write DMA Extended	35 _H
Write DMA FUA Extended	3D _H
Write DMA Without Retries	CB _H
Write Log Extended	3F _H
Write Multiple	C5 _H
Write Multiple Extended	39 _H
Write Multiple FUA Extended	CE _H
Write Sectors	30 _H
Write Sectors Without Retries	31 _H
Write Sectors Extended	34 _H
Write Uncorrectable	45 _H

4.3.1 Identify Device command

The Identify Device command (command code EC_H) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data, whose contents are shown in on page 34. All reserved bits or words should be set to zero. Parameters listed with an “x” are drive-specific or vary with the state of the drive.

The following commands contain drive-specific features that may not be included in the Serial ATA specification.

Word	Description	Value
0	Configuration information: Bit 15: 0 = ATA; 1 = ATAPI Bit 7: removable media Bit 6: removable controller Bit 0: reserved	0C5A _H
1	Number of logical cylinders	16,383
2	ATA-reserved	0000 _H
3	Number of logical heads	16
4	Retired	0000 _H
5	Retired	0000 _H
6	Number of logical sectors per logical track: 63	003F _H
7–9	Retired	0000 _H
10–19	Serial number: (20 ASCII characters, 0000 _H = none)	ASCII
20	Retired	0000 _H
21	Retired	0400 _H
22	Obsolete	0000 _H
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	x.xx
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8010 _H
48	Reserved	0000 _H
49	Standard Standby timer, IORDY supported and may be disabled	2F00 _H
50	ATA-reserved	0000 _H
51	PIO data-transfer cycle timing mode	0200 _H
52	Retired	0200 _H
53	Words 54–58, 64–70 and 88 are valid	0007 _H
54	Number of current logical cylinders	xxxx _H
55	Number of current logical heads	xxxx _H

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Word	Description	Value
56	Number of current logical sectors per logical track	xxxx _H
57–58	Current capacity in sectors	xxxx _H
59	Number of sectors transferred during a Read Multiple or Write Multiple command	xxxx _H
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information) *Note: The maximum value allowed in this field is: 0FFFFFFFh (268,435,455 sectors, 137GB). Drives with capacities over 137GB will have 0FFFFFFFh in this field and the actual number of user-addressable LBAs specified in words 100-103. This is required for drives that support the 48-bit addressing feature.	0FFFFFFFh*
62	Retired	0000 _H
63	Multiword DMA active and modes supported (see note following this table)	xx07 _H
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003 _H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078 _H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078 _H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	0078 _H
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69–74	ATA-reserved	0000 _H
75	Queue depth	001F _H
76	Serial ATA capabilities	xxxx _H
77	Reserved for future Serial ATA definition	xxxx _H
78	Serial ATA features supported	xxxx _H
79	Serial ATA features enabled	xxxx _H
80	Major version number	01F0 _H
81	Minor version number	0028 _H
82	Command sets supported	364B _H
83	Command sets supported	7F09 _H
84	Command sets support extension (see note following this table)	4163 _H
85	Command sets enabled	30xx _H
86	Command sets enabled	BE09 _H

Word	Description	Value
87	Command sets enable extension	4163 _H
88	Ultra DMA support and current mode (see note following this table)	xx7F _H
89	Security erase time	0039 _H
90	Enhanced security erase time	0039 _H
92	Master password revision code	FFFE _H
93	Hardware reset value	xxxx _H
94	Automatic acoustic management	8080 _H
95–99	ATA-reserved	0000 _H
100–103	Total number of user-addressable LBA sectors available (see Section 2.2 for related information). These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFh.	ST3000DM001 = 1,953,525,168 ST2500DM001 = 1,465,149,168 ST2000DM001 = 976,773,168 ST1500DM003 = 625,142,448 ST1000DM003 = 488,397,168 ST750DM003 = 312,581,808
104–107	ATA-reserved	0000 _H
108–111	The mandatory value of the world wide name (WWN) for the drive. NOTE: This field is valid if word 84, bit 8 is set to 1 indicating 64-bit WWN support.	Each drive will have a unique value.
112–127	ATA-reserved	0000 _H
128	Security status	0001 _H
129–159	Seagate-reserved	xxxx _H
160–254	ATA-reserved	0000 _H
255	Integrity word	xxA5 _H

Note

Advanced Power Management (APM) and Automatic Acoustic Management (AAM) features are not supported.

Note

See the bit descriptions below for words 63, 84, and 88 of the Identify Drive data.

Description (if bit is set to 1)		
	Bit	Word 63
	0	Multiword DMA mode 0 is supported.
	1	Multiword DMA mode 1 is supported.
	2	Multiword DMA mode 2 is supported.
	8	Multiword DMA mode 0 is currently active.
	9	Multiword DMA mode 1 is currently active.
	10	Multiword DMA mode 2 is currently active.

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	Bit	Word 84
	0	SMART error login is supported.
	1	SMART self-test is supported.
	2	Media serial number is supported.
	3	Media Card Pass Through Command feature set is supported.
	4	Streaming feature set is supported.
	5	GPL feature set is supported.
	6	WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported.
	7	WRITE DMA QUEUED FUA EXT command is supported.
	8	64-bit World Wide Name is supported.
	9-10	Obsolete.
	11-12	Reserved for TLC.
	13	IDLE IMMEDIATE command with IUNLOAD feature is supported.
	14	Shall be set to 1.
	15	Shall be cleared to 0.
	Bit	Word 88
	0	Ultra DMA mode 0 is supported.
	1	Ultra DMA mode 1 is supported.
	2	Ultra DMA mode 2 is supported.
	3	Ultra DMA mode 3 is supported.
	4	Ultra DMA mode 4 is supported.
	5	Ultra DMA mode 5 is supported.
	6	Ultra DMA mode 6 is supported.
	8	Ultra DMA mode 0 is currently active.
	9	Ultra DMA mode 1 is currently active.
	10	Ultra DMA mode 2 is currently active.
	11	Ultra DMA mode 3 is currently active.
	12	Ultra DMA mode 4 is currently active.
	13	Ultra DMA mode 5 is currently active.
	14	Ultra DMA mode 6 is currently active.

4.3.2 Set Features command

This command controls the implementation of various features that the drive supports. When the drive receives this command, it sets BSY, checks the contents of the Features register, clears BSY and generates an interrupt. If the value in the register does not represent a feature that the drive supports, the command is aborted. Power-on default has the read look-ahead and write caching features enabled. The acceptable values for the Features register are defined as follows:

02 _H	Enable write cache (<i>default</i>).
03 _H	Set transfer mode (based on value in Sector Count register). Sector Count register values:
	00 _H Set PIO mode to default (PIO mode 2).
	01 _H Set PIO mode to default and disable IORDY (PIO mode 2).
	08 _H PIO mode 0
	09 _H PIO mode 1
	0A _H PIO mode 2
	0B _H PIO mode 3
	0C _H PIO mode 4 (<i>default</i>)
	20 _H Multiword DMA mode 0
	21 _H Multiword DMA mode 1
	22 _H Multiword DMA mode 2
	40 _H Ultra DMA mode 0
	41 _H Ultra DMA mode 1
	42 _H Ultra DMA mode 2
	43 _H Ultra DMA mode 3
	44 _H Ultra DMA mode 4
	45 _H Ultra DMA mode 5
	46 _H Ultra DMA mode 6
10 _H	Enable use of SATA features
55 _H	Disable read look-ahead (read cache) feature.
82 _H	Disable write cache
90 _H	Disable use of SATA features
AA _H	Enable read look-ahead (read cache) feature (<i>default</i>).
F1 _H	Report full capacity available

Note

At power-on, or after a hardware or software reset, the default values of the features are as indicated above.

4.3.3 S.M.A.R.T. commands

S.M.A.R.T. provides near-term failure prediction for disk drives. When S.M.A.R.T. is enabled, the drive monitors predetermined drive attributes that are susceptible to degradation over time. If self-monitoring determines that a failure is likely, S.M.A.R.T. makes a status report available to the host. Not all failures are predictable. S.M.A.R.T. predictability is limited to the attributes the drive can monitor. For more information on S.M.A.R.T. commands and implementation, see the *Draft ATA-5 Standard*.

SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for D4_H) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at:

<http://seatools.seagate.com>.

This drive is shipped with S.M.A.R.T. features disabled. You must have a recent BIOS or software package that supports S.M.A.R.T. to enable this feature. The table below shows the S.M.A.R.T. command codes that the drive uses.

Code in features register	S.M.A.R.T. command
D0 _H	S.M.A.R.T. Read Data
D2 _H	S.M.A.R.T. Enable/Disable Attribute Autosave
D3 _H	S.M.A.R.T. Save Attribute Values
D4 _H	S.M.A.R.T. Execute Off-line Immediate (runs DST)
D5 _H	S.M.A.R.T. Read Log Sector
D6 _H	S.M.A.R.T. Write Log Sector
D8 _H	S.M.A.R.T. Enable Operations
D9 _H	S.M.A.R.T. Disable Operations
DA _H	S.M.A.R.T. Return Status

Note

If an appropriate code is not written to the Features Register, the command is aborted and 0x04 (abort) is written to the Error register.

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EXHIBIT 7



Product Manual

Seagate[®] Desktop HDD

Standard models

ST3000DM001
ST2000DM001
ST1500DM003
ST1000DM003
ST750DM003
ST500DM002
ST320DM000
ST250DM000

Self-Encryption models

ST3000DM002
ST2000DM002
ST1000DM004

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Revision	Date	Description of Change
Rev. A	08/19/2011	Initial release.
Rev. B	09/01/2011	Updated decibel specifications, start/stop times; Table 3; mounting drawing.
Rev. C	10/20/2011	Updated voltage tolerance specifications.
Rev. D	01/17/2012	Corrected Table 1 (Altitude, operating) specification and Table 5 (Idle2).
Rev. E	06/11/2012	Updated Index.
Rev. F	09/05/2012	Added 2.5A spin-up code option (Table 1 and Table 2); page 17.
Rev. G	10/01/2012	Updated Table 1 and Table 2 with rated workload information. Updated DC power requirements (Tables 1, 3 and 4).
Rev. H	03/21/2014	Revised Rated Workload statement (pages 5 & 7); LP height updated & new mechanical drawings (pages 4, 9 & 20-21); Revised max storage note (page 13)
Rev. J	05/08/2014	Updated product name (pages fc, 2, 19 & 22) and Add metric "mm" values to mechanical drawings. (pages 20-21).
Rev. K	08/28/2014	Add SED models and SED Section 4.0 (pages: fc, 2, 4, 7, 22-23 & 29)
Rev. L	01/26/2015	Applied new logo (pages: fc & bc), applied latest page numbering convention (pages: all), added AFR = <1.0% & update Rated Workload text (pages: 9 & 11), added Case Temp note & changed "&" to "%" in Storage note (page: 17), add Reliability Section 2.12 (page: 20), cleaned up text in Mechanical Drawings (pages: 24-25) & revised SED section 4.0 (pages: 26-27).

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When referring to drive capacity, one gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity. In addition, some of the listed capacity is used for formatting and other functions, and thus will not be available for data storage. Actual quantities will vary based on various factors, including file size, file format, features and application software. Actual data rates may vary depending on operating environment and other factors. The export or re-export of hardware or software containing encryption may be regulated by the U.S. Department of Commerce, Bureau of Industry and Security (for more information, visit www.bis.doc.gov), and controlled for import

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1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following:
Seagate® Desktop HDD model drives:

Standard models		Self-Encryption models
ST3000DM001	ST750DM003	ST3000DM002
ST2000DM001	ST500DM002	ST2000DM002
ST1500DM003	ST320DM000	ST1000DM004
ST1000DM003	ST250DM000	

Previous generations of Seagate Self-Encrypting Drive models were called Full Disk Encryption (FDE) models before a differentiation between drive-based encryption and other forms of encryption was necessary.

These drives provide the following key features:

- 7200 RPM spindle speed.
- High instantaneous (burst) data-transfer rates (up to 600MB per second).
- TGMR recording technology provides the drives with increased areal density.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Native Command Queuing with command ordering to increase performance in demanding applications.
- Full-track multiple-sector transfer capability without local processor intervention.
- Seagate AcuTrac™ servo technology delivers dependable performance, even with hard drive track widths of only 75 nanometers.
- Seagate OptiCache™ technology boosts overall performance by as much as 45% over the previous generation.
- Seagate SmartAlign™ technology provides a simple, transparent migration to Advanced Format 4K sectors
- Quiet operation.
- Compliant with RoHS requirements in China and Europe.
- SeaTools diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Supports latching SATA cables and connectors.
- Worldwide Name (WWN) capability uniquely identifies the drive.

1.1 About the SATA interface

The Serial ATA (SATA) interface provides several advantages over the traditional (parallel) ATA interface. The primary advantages include:

- Easy installation and configuration with true plug-and-play connectivity. It is not necessary to set any jumpers or other configuration options.
- Thinner and more flexible cabling for improved enclosure airflow and ease of installation.
- Scalability to higher performance levels.

In addition, SATA makes the transition from parallel ATA easy by providing legacy software support. SATA was designed to allow users to install a SATA host adapter and SATA disk drive in the current system and expect all of the existing applications to work as normal.

The SATA interface connects each disk drive in a point-to-point configuration with the SATA host adapter. There is no master/slave relationship with SATA devices like there is with parallel ATA. If two drives are attached on one SATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. This essentially means both drives behave as if they are Device 0 (master) devices.

The SATA host adapter and drive share the function of emulating parallel ATA device behavior to provide backward compatibility with existing host systems and software. The Command and Control Block registers, PIO and DMA data transfers, resets, and interrupts are all emulated.

The SATA host adapter contains a set of registers that shadow the contents of the traditional device registers, referred to as the Shadow Register Block. All SATA devices behave like Device 0 devices. For additional information about how SATA emulates parallel ATA, refer to the “Serial ATA International Organization: Serial ATA Revision 3.0”. The specification can be downloaded from www.sata-io.org.



The host adapter may, optionally, emulate a master/slave environment to host software where two devices on separate SATA ports are represented to host software as a Device 0 (master) and Device 1 (slave) accessed at the same set of host bus addresses. A host adapter that emulates a master/slave environment manages two sets of shadow registers. This is not a typical SATA environment.

2.0 Drive Specifications

Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, and nominal power. For convenience, the phrases *the drive* and *this drive* are used throughout this manual to indicate the following drive models:

Standard models		Self-Encryption models
ST3000DM001	ST750DM003	ST3000DM002
ST2000DM001	ST500DM002	ST2000DM002
ST1500DM003	ST320DM000	ST1000DM004
ST1000DM003	ST250DM000	

2.1 Specification summary tables

The specifications listed in **Table 1** and **Table 2** are for quick reference. For details on specification measurement or definition, refer to the appropriate section of this manual.

Table 1 Drive specifications summary for 3TB, 2TB, 1.5TB, 1TB and 750GB models

Drive Specification*	ST3000DM001 & ST3000DM002; ST2000DM001	ST2000DM001 & ST2000DM002; ST1500DM003	ST1000DM003 & ST1000DM004; ST750DM003
Formatted capacity (512 bytes/sector)**	3000GB (3TB); 2000GB (2TB)	2000GB (2TB); 1500GB (1.5TB)	1000GB (1TB); 750GB
Guaranteed sectors	5,860,533,168; 3,907,029,168	3,907,029,168; 2,930,277,168	1,953,525,168; 1,465,149,168
Heads	6	4	2
Disks	3	2	1
Bytes per sector (4K physical emulated at 512-byte sectors)	4096		
Default sectors per track	63		
Default read/write heads	16		
Default cylinders	16,383		
Recording density (max)	1807kFCI		
Track density (avg)	352ktracks/in		
Areal density (avg)	625Gb/in ²		
Spindle speed	7200 RPM		
Internal data transfer rate (max)	2147Mb/s		
Average data rate, read/write (MB/s)	156MB/s		
Maximum sustained data rate, OD read (MB/s)	210MB/s		
I/O data-transfer rate (max)	600MB/s		
Cache buffer	64MB		
Height (max)	26.1mm / 1.028 in		19.98mm / 0.787 in
Width (max)	101.6mm / 4.0 in (± 0.010 in)		101.6mm / 4.0 in (± 0.010 in)
Length (max)	146.99mm / 5.787 in		146.99mm / 5.787 in
Weight (typical)	626g / 1.38 lb	535g / 1.18 lb	400g / 0.88 lb
Average latency	4.16ms		
Power-on to ready (max)	<17.0s		<10.0s
Power-on to ready, 2.5A spin-up code option (typical)	<10.0s		n/a
Standby to ready (max)	<17.0s		<10.0s
Average seek, read (typical)	<8.5ms typical		
Average seek, write (typical)	<9.5ms typical		
Startup current 12V	2.0A or 2.8A		2.0A

Table 1 Drive specifications summary for 3TB, 2TB, 1.5TB, 1TB and 750GB models (continued)

Drive Specification*	ST3000DM001 & ST3000DM002; ST2000DM001	ST2000DM001 & ST2000DM002; ST1500DM003	ST1000DM003 & ST1000DM004; ST750DM003
Voltage tolerance (including noise)	5V: $\pm 5\%$ 12V: $+10\%$ / -7.5%		
Ambient temperature	0° to 60°C (operating) -40° to 70°C (non-operating)		
Temperature gradient	20°C per hour max (operating) 30°C per hour max (non-operating)		
Relative humidity	5% to 95% (operating) 5% to 95% (non-operating)		
Relative humidity gradient (max)	30% per hour		
Wet bulb temperature (max)	37.7°C max (operating) 40.0°C max (non-operating)		
Altitude, operating	-304.8m to 3048m (-1000 ft to 10,000+ ft)		
Altitude, non-operating (below mean sea level, max)	-304.8m to 12,192m (-1000 ft to 40,000+ ft)		
Operational shock (max)	80 Gs at 2ms		
Non-operational shock (max)	300 Gs at 2ms		350 Gs at 2ms
Vibration, operating	2Hz to 22Hz: 0.25 Gs, Limited displacement 22Hz to 350Hz: 0.50 Gs 350Hz to 500Hz: 0.25 Gs		
Vibration, non-operating	5Hz to 22Hz: 3.0 Gs 22Hz to 350Hz: 3.0 Gs 350Hz to 500Hz: 3.0 Gs		
Drive acoustics, sound power Idle***	2.4 bels (typical) 2.6 bels (max)		2.2 bels (typical) 2.4 bels (max)
Seek	2.6 bels (typical) 2.7 bels (max)		2.4 bels (typical) 2.5 bels (max)
Non-recoverable read errors	1 per 10^{14} bits read		
Annualized Failure Rate (AFR)	<1.0% based on 2400 POH		
Maximum Rated workload	Maximum rate of <55TB/year Workloads exceeding the annualized rate may impact product reliability. The Annualized Workload Rate is in units of TB per year, or TB per 2400 power on hours. Workload Rate = TB transferred * (2400 / recorded power on hours).		
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: http://www.seagate.com/support/warranty-and-replacements/ . From this page, click on "Check to see if the drive is under Warranty". Users will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for the drive.		
Load/Unload cycles (25°C, 50% rel. humidity)	300,000		
Supports Hotplug operation per the Serial ATA Revision 3.2 specification	Yes		

*All specifications above are based on native configurations.

** One GB equals one billion bytes and 1TB equals one trillion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

*** During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

Table 2 Drive specifications summary for 500GB, 320GB and 250GB models

Drive Specification*	ST500DM002	ST320DM000	ST250DM000
Formatted capacity**	500GB	320GB	250GB
Guaranteed sectors	976,773,168	625,142,448	488,397,168
Heads	2		1
Disks	1		
Bytes per sector (4K physical emulated at 512-byte sectors)	4096		
Default sectors per track	63		
Default read/write heads	16		
Default cylinders	16,383		
Recording density (max)	1413kb/in		
Track density (avg)	236ktracks/in		
Areal density (avg)	329Gb/in ²		
Spindle speed	7200 RPM		
Internal data transfer rate (max)	1695Mb/s		
Average Data Rate, read/write (MB/s)	125MB/s		
Maximum sustained data transfer rate, OD read	144MB/s		
I/O data-transfer rate (max.)	600MB/s		
Cache buffer	16MB		
Height (max)	19.98mm / 0.787 in		
Width (max)	101.6mm / 4.0 in (± 0.010 in)		
Length (max)	146.99mm / 5.787 in		
Weight (typical)	415g / 0.915 lb		
Average latency	4.16ms		
Power-on to ready (max)	<8.5s		
Standby to ready (max)	<8.5s		
Average seek, read (typical)	<8.5ms (read)		
Average seek, write (typical)	<9.5ms (write)		
Startup current (typical) 12V	2.0A		
Voltage tolerance (including noise)	5V: ±5% 12V: +10% / -7.5%		
Ambient temperature	0° to 60°C (operating) -40° to 70°C (non-operating)		
Temperature gradient	20°C per hour max (operating) 30°C per hour max (non-operating)		
Relative humidity	5% to 95% (operating) 5% to 95% (non-operating)		
Relative humidity gradient (max)	30% per hour		
Wet bulb temperature (max)	37.7°C (operating) 40.0°C (non-operating)		
Altitude, operating	-304.8m to 3048m (-1000 ft to 10,000+ ft)		
Altitude, non-operating (below mean sea level, max)	-304.8m to 12,192m (-1000 ft to 40,000+ ft)		
Operational shock (max)	70 Gs at 2ms		
Non-operational shock (max)	350 Gs at 2ms		
Vibration, operating	2Hz to 22Hz: 0.25 Gs, Limited displacement 22Hz to 350Hz: 0.50 Gs 350Hz to 500Hz: 0.25 Gs		
Vibration, non-operating	5Hz to 22Hz: 3.0 Gs 22Hz to 350Hz: 3.0 Gs 350Hz to 500Hz: 3.0 Gs		
Drive acoustics, sound power			

Table 2 Drive specifications summary for 500GB, 320GB and 250GB models (continued)

Drive Specification*	ST500DM002	ST320DM000	ST250DM000
Idle***		2.2 bels (typical) 2.3 bels (max)	
Seek		2.3 bels (typical) 2.4 bels (max)	
Non-recoverable read errors	1 per 10 ¹⁴ bits read		
Annualized Failure Rate (AFR)	<1.0% based on 2400 POH		
Maximum Rated workload	Maximum rate of <55TB/year Workloads exceeding the annualized rate may impact product reliability. The Annualized Workload Rate is in units of TB per year, or TB per 2400 power on hours. Workload Rate = TB transferred * (2400 / recorded power on hours).		
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: http://www.seagate.com/support/warranty-and-replacements/ . From this page, click on "Check to see if the drive is under Warranty". Users will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for the drive.		
Contact start-stop cycles	50,000 at 25°C, 50% rel. humidity		
Supports Hotplug operation per the Serial ATA Revision 3.2 specification	Yes		

* All specifications above are based on native configurations.

** One GB equals one billion bytes and 1TB equals one trillion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

*** During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

2.2 Formatted capacity

Model	Formatted capacity*	Guaranteed sectors	Bytes per sector
ST3000DM001 ST3000DM002	3000GB	5,860,533,168	4K
ST2000DM001 ST2000DM002	2000GB	3,907,029,168	
ST1500DM003	1500GB	2,930,277,168	
ST1000DM003 ST1000DM004	1000GB	1,953,525,168	
ST750DM003	750GB	1,465,149,168	
ST500DM002	500GB	976,773,168	
ST320DM000	320GB	625,142,448	
ST250DM000	250GB	488,397,168	

*One GB equals one billion bytes and 1TB equals one trillion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

2.2.1 LBA mode

When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to $n-1$, where n is the number of guaranteed sectors as defined above.

See Section 5.3.1, "Identify Device command" (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137GB.

2.3 Default logical geometry

Cylinders: 16,383

Read/write heads: 16

Sectors per track: 63

LBA mode

When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to $n-1$, where n is the number of guaranteed sectors as defined above.

2.4 Recording and interface technology

Interface	SATA
Recording method	TGMR
Recording density (kFCI)	
3TB, 2TB, 1.5TB, 1TB and 750GB models	1807
500GB, 320GB and 250GB models	1413
Track density (ktracks/inch avg)	352
Areal density (Gb/in²)	
3TB, 2TB, 1.5TB, 1TB and 750GB models	625
500GB, 320GB, 250GB models	329
Spindle speed (RPM)	7200 ± 0.2%
Internal data transfer rate (Mb/s max)	2147
Maximum sustained data transfer rate, OD read (MB/s)	
3TB, 2TB, 1.5TB, 1TB and 750GB models	210
500GB, 320GB, 250GB models	144
Average data rate, read/write (MB/s)	
3TB, 2TB, 1.5TB, 1TB and 750GB models	156
500GB, 320GB, 250GB models	125
I/O data-transfer rate (MB/s max)	600

2.5 Physical characteristics

Maximum height	
3TB, 2TB and 1.5TB	26.1mm / 1.028 in
1TB, 750GB, 500GB, 320GB, 250GB	19.98mm / 0.787 in
Maximum width (all models)	101.6mm / 4.0 in (± 0.010 in)
Maximum length (all models)	146.99mm / 5.787 in
Typical weight	
3TB and 2TB	626g / 1.38 lb
1.5TB	535g / 1.18 lb
1TB and 750GB	400g / 0.88 lb
500GB, 320GB, 250GB	415g / 0.92 lb
Cache buffer	
3TB, 2TB, 1.5TB, 1TB, 750GB	64MB (64,768kb)
500GB, 320GB and 250GB	16MB (16,384kb)

2.6 Seek time

Seek measurements are taken with nominal power at 25°C ambient temperature. All times are measured using drive diagnostics. The specifications in the table below are defined as follows:

Track-to-track seek time is an average of all possible single-track seeks in both directions.

Average seek time is a true statistical random average of at least 5000 measurements of seeks between random tracks, less overhead.

Typical seek times (ms)	Read	Write
Track-to-track	1.0	1.2
Average	8.5	9.5
Average latency	4.16	

These drives are designed to consistently meet the seek times represented in this manual. Physical seeks, regardless of mode (such as track-to-track and average), are expected to meet the noted values. However, due to the manner in which these drives are formatted, benchmark tests that include command overhead or measure logical seeks may produce results that vary from these specifications.

2.7 Start/stop times

	3-disk (3TB, 2TB models)	2-disk (2TB, 1.5TB models)	1-disk (1TB, 750GB models)	1-disk (250GB, 320GB, 500GB models)
Power-on to ready (in seconds)	15 (typical) 17 (max)		10 (typical) 12 (max)	8.5 (typical) 10 (max)
Power-on to ready, 2.5A spin-up code option (in seconds, typical)	<10		n/a	
Standby to ready (in seconds)	15 (typical) 17 (max)		10 (typical) 12 (max)	8.5 (typical) 10 (max)
Ready to spindle stop (in seconds)	10 (typical) 11 (max)		10 (typical) 11 (max)	

Time-to-ready may be longer than normal if the drive power is removed without going through normal OS powerdown procedures.

2.8 Power specifications

The drive receives DC power (+5V or +12V) through a native SATA power connector. Refer to **Figure 1 on page 23**.

2.8.1 Power consumption

Power requirements for the drives are listed in **Table 3**, **Table 4**, **Table 5** and **Table 6**. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V and 12.0V input voltage at 25°C ambient temperature.

Spinup power

Spinup power is measured from the time of power-on to the time that the drive spindle reaches operating speed.

Read/write power and current

Read/write power is measured with the heads on track, based on a 16-sector write followed by a 32-ms delay, then a 16-sector read followed by a 32-ms delay.

Operating power and current

Operating power is measured using 40 percent random seeks, 40 percent read/write mode (1 write for each 10 reads) and 20 percent drive idle mode.

Idle mode power

Idle mode power is measured with the drive up to speed, with servo electronics active and with the heads in a random track location.

Standby mode

During Standby mode, the drive accepts commands, but the drive is not spinning, and the servo and read/write electronics are in power-down mode.

Table 3 DC power requirements (3-disk: 3TB and 2TB models)

Power dissipation (3-disk values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V amps
Spinup	—	—	2.0A or 2.8A
Idle2* †	5.40	0.190	0.377
Operating	8.00	0.510	0.462
Standby	0.75	0.136	0.005
Sleep	0.75	0.136	0.005

Table 4 DC power requirements (2-disk: 2TB and 1.5TB models)

Power dissipation (2-disk values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V amps
Spinup	—	—	2.0A or 2.8A
Idle2* †	4.50	0.196	0.296
Operating	6.70	0.525	0.340
Standby	0.75	0.136	0.005
Sleep	0.75	0.136	0.005

Table 5 DC power requirements (1-disk: 1TB and 750GB models)

Power dissipation (1-disk values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V amps
Spinup	—	—	2.0
Idle2* †	3.36	0.152	0.216
Operating	5.90	0.500	0.329
Standby	0.63	0.111	0.006
Sleep	0.63	0.111	0.006

Table 6 DC power requirements (1-disk: 500, 320 and 250GB models)

Power dissipation (1-disk values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V typ amps
Spinup	—	—	2.0
Perf Idle* †	4.60	0.378	0.224
Operating	6.19	0.656	0.243
Standby	0.79	0.350	0.010
Sleep	0.79	0.350	0.010

*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

†5W IDLE with DIPLM Enabled

2.8.2 Conducted noise

Input noise ripple is measured at the host system power supply across an equivalent 80-ohm resistive load on the +12 volt line or an equivalent 15-ohm resistive load on the +5 volt line.

Using 12-volt power, the drive is expected to operate with a maximum of 120 mV peak-to-peak square-wave injected noise at up to 10MHz.

Using 5-volt power, the drive is expected to operate with a maximum of 100 mV peak-to-peak square-wave injected noise at up to 10MHz.

Equivalent resistance is calculated by dividing the nominal voltage by the typical RMS read/write current.

2.8.3 Voltage tolerance

Voltage tolerance (including noise):

5V $\pm 5\%$

12V $+10\%$ / -7.5%

2.8.4 Power-management modes

The drive provides programmable power management to provide greater energy efficiency. In most systems, users can control power management through the system setup program. The drive features the following power-management modes:

Power modes	Heads	Spindle	Buffer
Active	Tracking	Rotating	Enabled
Idle	Tracking	Rotating	Enabled
Standby	Parked	Stopped	Enabled
Sleep	Parked	Stopped	Disabled

Active mode

The drive is in Active mode during the read/write and seek operations.

Idle mode

The buffer remains enabled, and the drive accepts all commands and returns to Active mode any time disk access is necessary.

Standby mode

The drive enters Standby mode when the host sends a Standby Immediate command. If the host has set the standby timer, the drive can also enter Standby mode automatically after the drive has been inactive for a specifiable length of time. The standby timer delay is established using a Standby or Idle command. In Standby mode, the drive buffer is enabled, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disk access is necessary.

Sleep mode

The drive enters Sleep mode after receiving a Sleep command from the host. In Sleep mode, the drive buffer is disabled, the heads are parked and the spindle is at rest. The drive leaves Sleep mode after it receives a Hard Reset or Soft Reset from the host. After receiving a reset, the drive exits Sleep mode and enters Standby mode with all current translation parameters intact.

Idle and Standby timers

Each time the drive performs an Active function (read, write or seek), the standby timer is reinitialized and begins counting down from its specified delay times to zero. If the standby timer reaches zero before any drive activity is required, the drive makes a transition to Standby mode. In both Idle and Standby mode, the drive accepts all commands and returns to Active mode when disk access is necessary.

2.9 Environmental specifications

This section provides the temperature, humidity, shock, and vibration specifications. Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Above 1000ft. (305 meters), the maximum temperature is derated linearly by 1°C every 1000 ft.

The maximum allowable drive case temperature is 60°C.
See Figures 2 & 3 for HDA case temperature measurement locations.

Refer to Section 3.4 Drive mounting for base plate measurement location.

2.9.1 Ambient temperature

Operating	0° to 60°C (32° to 140°F)
Non-operating	–40° to 70°C (–40° to 158°F)

2.9.2 Temperature gradient

Operating	20°C per hour (68°F per hour max), without condensation
Non-operating	30°C per hour (86°F per hour max)

2.9.3 Humidity

2.9.3.1 Relative humidity

Operating	5% to 95% non-condensing (30% per hour max)
Nonoperating	5% to 95% non-condensing (30% per hour max)

2.9.3.2 Wet bulb temperature

Operating	37.7°C (99.9°F max)
Non-operating	40°C (104°F max)

2.9.4 Altitude

Operating	–304.8m to 3048m (–1000 ft. to 10,000+ ft.)
Non-operating	–304.8m to 12,192m (–1000 ft. to 40,000+ ft.)

Maximum storage condition not to exceed 90 days at a wetbulb temperature of 32°C (example: 34°C / 90% RH)

2.9.5 Shock

All shock specifications assume that the drive is mounted securely with the input shock applied at the drive mounting screws. Shock may be applied in the X, Y or Z axis.

2.9.5.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 80 Gs based on half-sine shock pulses of 2 ms during read operations. Shocks should not be repeated more than two times per second.

2.9.5.2 Non-operating shock

3TB, 2TB and 1.5TB models

The non-operating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 300 Gs based on a non-repetitive half-sine shock pulse of 2 ms duration.

1TB, 750GB, 500GB, 320GB and 250GB models

The non-operating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 350 Gs based on a non-repetitive half-sine shock pulse of 2-ms duration.

2.9.5.3 Operating vibration

The maximum vibration levels that the drive may experience while meeting the performance standards specified in this document are specified below.

2Hz to 22Hz	0.25 Gs (Limited displacement)
22Hz to 350Hz	0.50 Gs
350Hz to 500Hz	0.25 Gs

All vibration specifications assume that the drive is mounted securely with the input vibration applied at the drive mounting screws. Vibration may be applied in the X, Y or Z axis. Throughput may vary if improperly mounted.

2.9.6 Non-operating vibration

The maximum non-operating vibration levels that the drive may experience without incurring physical damage or degradation in performance when subsequently put into operation are specified below.

5Hz to 22Hz	3.0 Gs (Limited displacement)
22Hz to 350Hz	3.0 Gs
350Hz to 500Hz	3.0 Gs

2.10 Acoustics

Drive acoustics are measured as overall A-weighted acoustic sound power levels (no pure tones). All measurements are consistent with ISO document 7779. Sound power measurements are taken under essentially free-field conditions over a reflecting plane. For all tests, the drive is oriented with the cover facing upward.

For seek mode tests, the drive is placed in seek mode only. The number of seeks per second is defined by the following equation:

$$(\text{Number of seeks per second} = 0.4 / (\text{average latency} + \text{average access time}))$$

Table 7 Fluid Dynamic Bearing (FDB) motor acoustics

	Idle*	Seek
3 Disks (3TB, 2TB)	2.4 bels (typical) 2.6 bels (max)	2.6 bels (typical) 2.7 bels (max)
2 Disks (2TB, 1.5TB)		
1 Disk (1TB, 750GB)	2.2 bels (typical) 2.3 bels (max)	2.3 bels (typical) 2.4 bels (max)
1 Disk (500GB, 320GB, 250GB)	2.2 bels (typical) 2.4 bels (max)	2.4 bels (typical) 2.5 bels (max)

*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

2.10.1 Test for Prominent Discrete Tones (PDTs)

Seagate follows the ECMA-74 standards for measurement and identification of PDTs. An exception to this process is the use of the absolute threshold of hearing. Seagate uses this threshold curve (originated in ISO 389-7) to discern tone audibility and to compensate for the inaudible components of sound prior to computation of tone ratios according to Annex D of the ECMA-74 standards.

2.11 Electromagnetic immunity

When properly installed in a representative host system, the drive operates without errors or degradation in performance when subjected to the radio frequency (RF) environments defined in **Table 8**.

Table 8 Radio frequency environments

Test	Description	Performance level	Reference standard
Electrostatic discharge	Contact, HCP, VCP: ± 4 kV; Air: ± 8 kV	B	EN61000-4-2: 95
Radiated RF immunity	80MHz to 1,000MHz, 3 V/m, 80% AM with 1kHz sine 900MHz, 3 V/m, 50% pulse modulation @ 200Hz	A	EN61000-4-3: 96 ENV50204: 95
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN61000-4-5: 95
Conducted RF immunity	150kHz to 80MHz, 3 Vrms, 80% AM with 1kHz sine	A	EN61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN61000-4-11: 94

2.12 Reliability

2.12.1 Annualized Failure Rate (AFR)

The production disk drive shall achieve an annualized failure-rate of <1.0% over a 5 year service life when used in Desktop Storage field conditions as limited by the following:

- 2400 power-on-hours per year.
- Typical workload

Nonrecoverable read errors	1 per 10 ¹⁴ bits read, max
Maximum Rated Workload	Maximum rate of <55TB/year Workloads exceeding the annualized rate may impact product reliability. The Annualized Workload Rate is in units of TB per year, or TB per 2400 power on hours. Workload Rate = TB transferred * (2400 / recorded power on hours).
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: http://www.seagate.com/support/warranty-and-replacements/ . From this page, click on the "Check to see if the drive is under Warranty" link. The following are required to be provided: the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for the drive.
Preventive maintenance	None required.

2.13 Warranty

To determine the warranty for a specific drive, use a web browser to access the following web page: <http://www.seagate.com/support/warranty-and-replacements/>

From this page, click on "Check to see if the drive is under Warranty". Users will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for the drive.

2.14 Agency certification

2.14.1 Safety certification

These products are certified to meet the requirements of UL60950-1, CSA60950-1 and EN60950 and so marked as to the certify agency.

2.14.2 Electromagnetic compatibility

Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2004/108/EC) as put into place 20 July 2007. Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55022, Class B and the immunity levels are defined by EN 55024.

Drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports. Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products.

Korean RRL

If these drives have the Korean Communications Commission (KCC) logo, they comply with paragraph 1 of Article 11 of the Electromagnetic Compatibility control Regulation and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Communications Commission, Republic of Korea.

These drives have been tested and comply with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class B products. Drives are tested in a representative, end-user system by a Korean-recognized lab.

Family name: Barracuda

Certificate number: KCC-REM-STX-Barracuda

Australian C-Tick (N176)

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZ CISPR22 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

2.14.3FCC verification

These drives are intended to be contained solely within a personal computer or similar enclosure (not attached as an external device). As such, each drive is considered to be a subassembly even when it is individually marketed to the customer. As a subassembly, no Federal Communications Commission verification or certification of the device is required.

Seagate has tested this device in enclosures as described above to ensure that the total assembly (enclosure, disk drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J, Part 15 of the FCC rules. Operation with non-certified assemblies is likely to result in interference to radio and television reception.

Radio and television interference. This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception.

This equipment is designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television, which can be determined by turning the equipment on and off, users are encouraged to try one or more of the following corrective measures:

Reorient the receiving antenna.

Move the device to one side or the other of the radio or TV.

Move the device farther away from the radio or TV.

Plug the computer into a different outlet so that the receiver and computer are on different branch outlets.

If necessary, users should consult the dealer or an experienced radio/television technician for additional suggestions. Users may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems*. This booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

2.15 Environmental protection

Seagate designs its products to meet environmental protection requirements worldwide, including regulations restricting certain chemical substances.

2.15.1 European Union Restriction of Hazardous Substances (RoHS) Directive

The European Union Restriction of Hazardous Substances (RoHS) Directive, restricts the presence of chemical substances, including Lead, Cadmium, Mercury, Hexavalent Chromium, PBB and PBDE, in electronic products, effective July 2006. This drive is manufactured with components and materials that comply with the RoHS Directive.

2.15.2 China Restriction of Hazardous Substances (RoHS) Directive 中国限制危险物品的指令

This product has an Environmental Protection Use Period (EPUP) of 20 years. The following table contains information mandated by China's "Marking Requirements for Control of Pollution Caused by Electronic Information Products" Standard.



该产品具有20年的环境保护使用周期（EPUP）。下表包含了中国“电子产品所导致的污染的控制的记号要求”所指定的信息。

Name of Parts 部件名称	Toxic or Hazardous Substances or Elements 有毒有害物质或元素					
	Lead 铅 (Pb)	Mercury 汞 (Hg)	Cadmium 镉 (Cd)	Hexavalent Chromium 六价铬 (Cr6+)	Polybrominated Diphenyl 多溴联苯 (PBB)	Polybrominated Diphenyl Ether 多溴二苯醚 (PBDE)
PCBA	X	O	O	O	O	O
HDA	X	O	O	O	O	O

"O" indicates the hazardous and toxic substance content of the part (at the homogeneous material level) is lower than the threshold defined by the China RoHS MCV Standard.

“O”表示该部件（于同类物品程度上）所含的危险和有毒物质低于中国RoHS MCV标准所定义的门槛值。

"X" indicates the hazardous and toxic substance content of the part (at the homogeneous material level) is over the threshold defined by the China RoHS MCV Standard.

“X”表示该部件（于同类物品程度上）所含的危险和有毒物质超出中国RoHS MCV标准所定义的门槛值。

2.16 Corrosive environment

Seagate electronic drive components pass accelerated corrosion testing equivalent to 10 years exposure to light industrial environments containing sulfurous gases, chlorine and nitric oxide, classes G and H per ASTM B845. However, this accelerated testing cannot duplicate every potential application environment. Users should use caution exposing any electronic components to uncontrolled chemical pollutants and corrosive chemicals as electronic drive component reliability can be affected by the installation environment. The silver, copper, nickel and gold films used in Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or exposed to an ambient relative humidity greater than 95%. Materials used in cabinet fabrication, such as vulcanized rubber, that can outgas corrosive compounds should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.

3.0 Configuring and Mounting the Drive

This section contains the specifications and instructions for configuring and mounting the drive.

3.1 Handling and static-discharge precautions

After unpacking, and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

Caution

Before handling the drive, put on a grounded wrist strap, or ground oneself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.

Handle the drive by its edges or frame *only*.

The drive is extremely fragile—handle it with care. Do not press down on the drive top cover.

Always rest the drive on a padded, antistatic surface until mounting it in the computer.

Do not touch the connector pins or the printed circuit board.

Do not remove the factory-installed labels from the drive or cover them with additional labels. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive. Other labels are used to seal out dirt and contamination.

3.2 Configuring the drive

Each drive on the SATA interface connects point-to-point with the SATA host adapter. There is no master/slave relationship because each drive is considered a master in a point-to-point relationship. If two drives are attached on one SATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. Both drives behave as if they are Device 0 (master) devices.

SATA drives are designed for easy installation. It is usually not necessary to set any jumpers on the drive for proper operation; however, if users connect the drive and receive a “drive not detected” error, the SATA-equipped motherboard or host adapter may use a chipset that does not support SATA speed autonegotiation.

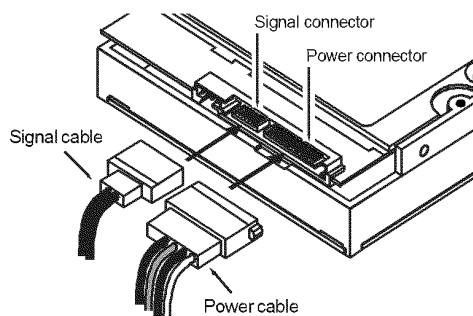
3.3 SATA cables and connectors

The SATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 inches). See **Table 9** for connector pin definitions. Either end of the SATA signal cable can be attached to the drive or host.

For direct backplane connection, the drive connectors are inserted directly into the host receptacle. The drive and the host receptacle incorporate features that enable the direct connection to be hot pluggable and blind mateable.

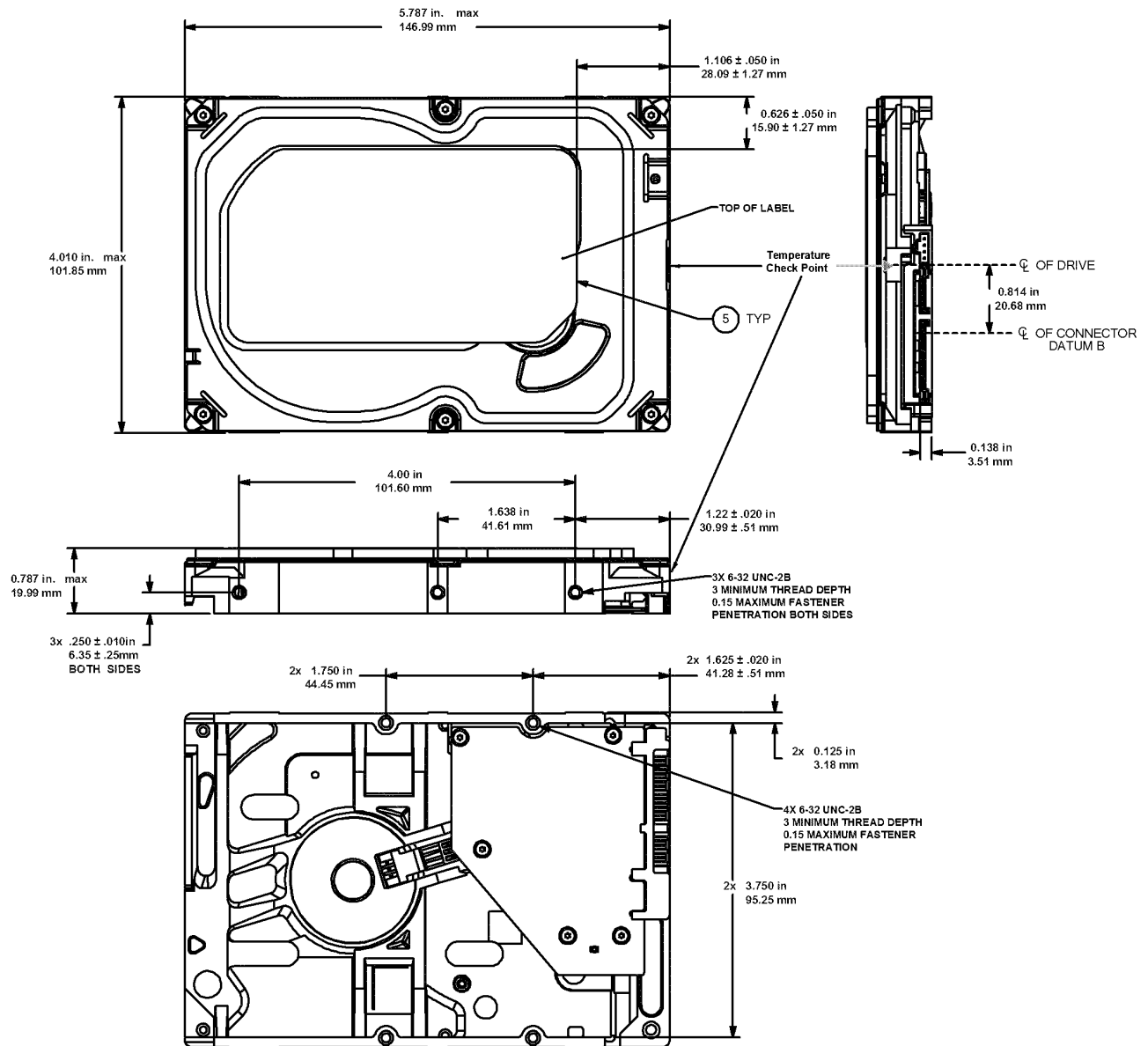
For installations which require cables, users can connect the drive as illustrated in **Figure 1**.

Figure 1 Attaching SATA cabling



Each cable is keyed to ensure correct orientation. Desktop HDD drives support latching SATA connectors.

Figure 3 Mounting dimensions (1-disk: 250GB to 1TB models)



Drawings are for mounting hole reference only.
PCBA show in pictorial only and can vary based on specific customer configurations.

4.0 About (SED) Self-Encrypting Drives

Self-encrypting drives (SEDs) offer encryption and security services for the protection of stored data, commonly known as "data at rest". These drives are compliant with the Trusted Computing Group (TCG) Opal Storage Specifications as detailed in the following:

TCG Storage Architecture Core Specification, Version 2.0 (see www.trustedcomputinggroup.org)

TCG Storage Security Subsystem Class Opal Specification, Version 2.0 (see www.trustedcomputinggroup.org)

In case of conflict between this document and any referenced document, this document takes precedence.

The Trusted Computing Group (TCG) is a standards organization sponsored and operated by companies in the computer, storage and digital communications industry. Seagate's SED models comply with the standards published by the TCG.

To use the security features in the drive, the host must be capable of constructing and issuing the following two SATA commands:

Trusted Send

Trusted Receive

These commands are used to convey the TCG protocol to and from the drive in their command payloads. Seagate Secure SEDs also support TCG Single User Mode, which can be disabled.

4.1 Data Encryption

Encrypting drives use one inline encryption engine within each drive employing AES-256 algorithms in Cipher Block Chaining (CBC) mode to encrypt all data prior to being written on the media and to decrypt all data as it is read from the media. The encryption engine is always in operation and cannot be disabled. The 32-byte Data Encryption Key (DEK) is a random number which is generated by the drive, never leaves the drive, and is inaccessible to the host system. The DEK is itself encrypted when it is stored on the media and when in volatile temporary storage (DRAM), which is external to the encryption engine. A unique data encryption key is used for each of the drive's possible 16 data bands (see **Section 4.5 Data Bands**).

4.2 Controlled Access

The drive has two security providers (SPs) called the "Admin SP" and the "Locking SP." These act as gatekeepers to the drive security services. Security-related commands will not be accepted unless the user provides the correct credentials to prove that they are authorized to perform the command.

4.2.1 Admin SP

The Admin SP allows the drive's owner to enable or disable firmware download operations (see **Section 4.4 Drive Locking**). Access to the Admin SP is available using the SID (Secure ID) password.

4.2.2 Locking SP

The Locking SP controls read/write access to the media and the cryptographic erase feature. Access to the Locking SP is available using the Admin or User passwords.

4.2.3 Default password

When the drive is shipped from the factory, all passwords are set to the value of MSID. This 32-byte random value can only be read by the host electronically over the interface. After receipt of the drive, it is the responsibility of the owner to use the default MSID password as the authority to change all other passwords to unique owner-specified values.

4.2.4 ATA Enhanced Security

The drive can utilize the system's BIOS through the ATA Security API for cases that do not require password management and additional security policies.

Furthermore, the drive's ATA Security Erase Unit command shall support both Normal and Enhanced Erase modes with the following modifications/additions:

Normal Erase: Normal erase feature shall be performed by changing the Data Encryption Key (DEK) of the drive, followed by an overwrite operation that repeatedly writes a single sector containing random data to the entire drive. This write operation bypasses the media encryption. On reading back the overwritten sectors, the host will receive a decrypted version, using the new DEK of the random data sector (the returned data will not match what was written).

Enhanced Erase: Enhanced erase shall be performed by changing the Data Encryption Key of the drive.

4.3 Random Number Generator (RNG)

The drive has a 32-byte hardware RNG that it uses to derive encryption keys or, if requested to do so, to provide random numbers to the host for system use, including using these numbers as Authentication Keys (passwords) for the drive's Admin and Locking SPs.

4.4 Drive Locking

In addition to changing the passwords, as described in **Section 4.2.3 Default password**, the owner should also set the data access controls for the individual bands.

The variable "LockOnReset" should be set to "PowerCycle" to ensure that the data bands will be locked if power is lost. In addition "ReadLockEnabled" and "WriteLockEnabled" must be set to true in the locking table in order for the bands "LockOnReset" setting of "PowerCycle" to actually lock access to the band when a "PowerCycle" event occurs. This scenario occurs if the drive is removed from its cabinet. The drive will not honor any data read or write requests until the bands have been unlocked. This prevents the user data from being accessed without the appropriate credentials when the drive has been removed from its cabinet and installed in another system.

4.5 Data Bands

When shipped from the factory, the drive is configured with a single data band called Band 0 (also known as the Global Data Band) which comprises LBA 0 through LBA max. The host may allocate additional bands (Band1 to Band15) by specifying a start LBA and an LBA range. The real estate for this band is taken from the Global Band.

Data bands cannot overlap but they can be sequential with one band ending at LBA (x) and the next beginning at LBA (x+1).

Each data band has its own drive-generated encryption key. The host may change the Encryption Key (see **Section 4.6 Cryptographic Erase**) or the password when required.

4.6 Cryptographic Erase

A valuable feature of SEDs is the ability to perform a cryptographic erase. This involves the host telling the drive to change the data encryption key for a particular band. Once changed, the data is no longer recoverable since it was written with one key and will be read using a different key. Since the drive overwrites the old key with the new one, and keeps no history of key the older key, the user data can never be recovered. This is done in a matter of seconds and is very useful if the drive is to be scrapped or repurposed.

4.7 Authenticated Firmware Download

In addition to providing a locking mechanism to prevent unwanted firmware download attempts, the drive also only accepts download files which have been cryptographically signed by the appropriate Seagate Design Center.

Three conditions must be met before the drive will allow the download operation:

1. The download must be an SED file. A standard drive (non-SED) file will be rejected.
2. The download file must be signed and authenticated.
3. As with a non-SED drive, the download file must pass the acceptance criteria for the drive. For example it must be applicable to the correct drive model, and have compatible revision and customer status.

4.8 Power Requirements

The standard drive models and the SED drive models have identical hardware, however the security and encryption portion of the drive controller ASIC is enabled and functional in the SED models. This represents a small additional drain on the 5V supply of about

30mA and a commensurate increase of about 150mW in power consumption. There is no additional drain on the 12V supply. See the tables in **Section 2.8 Power specifications** for power requirements on the standard (non-SED) drive models.

4.9 Supported Commands

The SED models support the following two commands in addition to the commands supported by the standard (non-SED) models as listed in **Table 10**:

Trusted Send
Trusted Receive

4.10 RevertSP

SED models will support the RevertSP feature which erases all data in all bands on the device and returns the contents of all SPs (Security Providers) on the device to their original factory state. In order to execute the RevertSP method the unique PSID (Physical Secure ID) printed on the drive label must be provided. PSID is not electronically accessible and can only be manually read from the drive label or scanned in via the 2D barcode.

5.0 SATA Interface

These drives use the industry-standard Serial ATA (SATA) interface that supports FIS data transfers. It supports ATA programmed input/output (PIO) modes 0 to 4; multiword DMA modes 0 to 2, and Ultra DMA modes 0 to 6.

For detailed information about the SATA interface, refer to the “Serial ATA: High Speed Serialized AT Attachment” specification.

5.1 Hot-Plug compatibility

Desktop HDD drives incorporate connectors which enable users to hot plug these drives in accordance with the SATA Revision 3.2 specification. This specification can be downloaded from www.serialata.org.

5.2 SATA device plug connector pin definitions

Table 9 summarizes the signals on the SATA interface and power connectors.

Table 9 SATA connector pin definitions

Segment	Pin	Function	Definition
Signal	S1	Ground	2nd mate
	S2	A+	Differential signal pair A from Phy
	S3	A-	
	S4	Ground	2nd mate
	S5	B-	Differential signal pair B from Phy
	S6	B+	
	S7	Ground	2nd mate
Key and spacing separate signal and power segments			
Power	P1	V ₃₃	3.3V power
	P2	V ₃₃	3.3V power
	P3	V ₃₃	3.3V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V ₅	5V power, pre-charge, 2nd mate
	P8	V ₅	5V power
	P9	V ₅	5V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive does not use deferred spin
	P12	Ground	1st mate.
	P13	V ₁₂	12V power, pre-charge, 2nd mate
	P14	V ₁₂	12V power
	P15	V ₁₂	12V power

Notes

- All pins are in a single row, with a 1.27 mm (0.050 in) pitch.
- The comments on the mating sequence apply to the case of backplane blindmate connector only. In this case, the mating sequences are:
 - the ground pins P4 and P12.
 - the pre-charge power pins and the other ground pins.
 - the signal pins and the rest of the power pins.
- There are three power pins for each voltage. One pin from each voltage is used for pre-charge when installed in a blind-mate backplane configuration.
 - All used voltage pins (V_x) must be terminated.

5.3 Supported ATA commands

The following table lists SATA standard commands that the drive supports.

For a detailed description of the ATA commands, refer to the Serial ATA International Organization: Serial ATA Revision 3.0 (<http://www.sata-io.org>).

See “S.M.A.R.T. commands” on page 36 for details and subcommands used in the S.M.A.R.T. implementation.

Table 10 SATA standard commands

Command name	Command code (in hex)
Check Power Mode	E5 _H
Device Configuration Freeze Lock	B1 _H / C1 _H
Device Configuration Identify	B1 _H / C2 _H
Device Configuration Restore	B1 _H / C0 _H
Device Configuration Set	B1 _H / C3 _H
Device Reset	08 _H
Download Microcode	92 _H
Execute Device Diagnostics	90 _H
Flush Cache	E7 _H
Flush Cache Extended	EA _H
Format Track	50 _H
Identify Device	EC _H
Idle	E3 _H
Idle Immediate	E1 _H
Initialize Device Parameters	91 _H
Read Buffer	E4 _H
Read DMA	C8 _H
Read DMA Extended	25 _H
Read DMA Without Retries	C9 _H
Read Log Ext	2F _H
Read Multiple	C4 _H
Read Multiple Extended	29 _H
Read Native Max Address	F8 _H
Read Native Max Address Extended	27 _H
Read Sectors	20 _H
Read Sectors Extended	24 _H
Read Sectors Without Retries	21 _H
Read Verify Sectors	40 _H
Read Verify Sectors Extended	42 _H
Read Verify Sectors Without Retries	41 _H
Recalibrate	10 _H
Security Disable Password	F6 _H
Security Erase Prepare	F3 _H
Security Erase Unit	F4 _H

Table 10 SATA standard commands (continued)

Command name	Command code (in hex)	
Security Freeze	F5 _H	
Security Set Password	F1 _H	
Security Unlock	F2 _H	
Seek	70 _H	
Set Features	EF _H	
Set Max Address	F9 _H	
Note: Individual Set Max Address commands are identified by the value placed in the Set Max Features register as defined to the right.	Address: Password: Lock: Unlock: Freeze Lock:	00 _H 01 _H 02 _H 03 _H 04 _H
Set Max Address Extended	37 _H	
Set Multiple Mode	C6 _H	
Sleep	E6 _H	
S.M.A.R.T. Disable Operations	B0 _H / D9 _H	
S.M.A.R.T. Enable/Disable Autosave	B0 _H / D2 _H	
S.M.A.R.T. Enable Operations	B0 _H / D8 _H	
S.M.A.R.T. Execute Offline	B0 _H / D4 _H	
S.M.A.R.T. Read Attribute Thresholds	B0 _H / D1 _H	
S.M.A.R.T. Read Data	B0 _H / D0 _H	
S.M.A.R.T. Read Log Sector	B0 _H / D5 _H	
S.M.A.R.T. Return Status	B0 _H / DA _H	
S.M.A.R.T. Save Attribute Values	B0 _H / D3 _H	
S.M.A.R.T. Write Log Sector	B0 _H / D6 _H	
Standby	E2 _H	
Standby Immediate	E0 _H	
Write Buffer	E8 _H	
Write DMA	CA _H	
Write DMA Extended	35 _H	
Write DMA FUA Extended	3D _H	
Write DMA Without Retries	CB _H	
Write Log Extended	3F _H	
Write Multiple	C5 _H	
Write Multiple Extended	39 _H	
Write Multiple FUA Extended	CE _H	
Write Sectors	30 _H	
Write Sectors Without Retries	31 _H	
Write Sectors Extended	34 _H	
Write Uncorrectable	45 _H	

5.3.1 Identify Device command

The Identify Device command (command code EC_H) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data, whose contents are shown in on page 29. All reserved bits or words should be set to zero. Parameters listed with an “x” are drive-specific or vary with the state of the drive.

The following commands contain drive-specific features that may not be included in the SATA specification.

Table 11 Identify Device commands

Word	Description	Value
0	Configuration information: Bit 15: 0 = ATA; 1 = ATAPI Bit 7: removable media Bit 6: removable controller Bit 0: reserved	0C5A _H
1	Number of logical cylinders	16,383
2	ATA-reserved	0000 _H
3	Number of logical heads	16
4	Retired	0000 _H
5	Retired	0000 _H
6	Number of logical sectors per logical track: 63	003F _H
7–9	Retired	0000 _H
10–19	Serial number: (20 ASCII characters, 0000 _H = none)	ASCII
20	Retired	0000 _H
21	Retired	0400 _H
22	Obsolete	0000 _H
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	x.xx
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8010 _H
48	Reserved	0000 _H
49	Standard Standby timer, IORDY supported and may be disabled	2F00 _H
50	ATA-reserved	0000 _H
51	PIO data-transfer cycle timing mode	0200 _H
52	Retired	0200 _H
53	Words 54–58, 64–70 and 88 are valid	0007 _H
54	Number of current logical cylinders	xxxx _H
55	Number of current logical heads	xxxx _H
56	Number of current logical sectors per logical track	xxxx _H
57–58	Current capacity in sectors	xxxx _H

Table 11 Identify Device commands (continued)

Word	Description	Value
59	Number of sectors transferred during a Read Multiple or Write Multiple command	xxxx _H
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information) *Note: The maximum value allowed in this field is: 0FFFFFFF _H (268,435,455 sectors, 137GB). Drives with capacities over 137GB will have 0FFFFFFF _H in this field and the actual number of user-addressable LBAs specified in words 100–103. This is required for drives that support the 48-bit addressing feature.	0FFFFFFF _H *
62	Retired	0000 _H
63	Multiword DMA active and modes supported (see note following this table)	xx07 _H
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003 _H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078 _H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078 _H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	0078 _H
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078 _H
69–74	ATA-reserved	0000 _H
75	Queue depth	001F _H
76	SATA capabilities	xxxx _H
77	Reserved for future SATA definition	xxxx _H
78	SATA features supported	xxxx _H
79	SATA features enabled	xxxx _H
80	Major version number	01F0 _H
81	Minor version number	0028 _H
82	Command sets supported	364B _H
83	Command sets supported	7F09 _H
84	Command sets support extension (see note following this table)	4163 _H
85	Command sets enabled	30xx _H
86	Command sets enabled	BE09 _H
87	Command sets enable extension	4163 _H
88	Ultra DMA support and current mode (see note following this table)	xx7F _H
89	Security erase time	0039 _H
90	Enhanced security erase time	0039 _H
92	Master password revision code	FFFE _H
93	Hardware reset value	xxxx _H
94	Automatic acoustic management	8080 _H
95–99	ATA-reserved	0000 _H

Table 11 Identify Device commands (continued)

Word	Description	Value
100–103	Total number of user-addressable LBA sectors available (see Section 2.2 for related information). These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFH.	ST3000DM001 = 5,860,533,168 ST3000DM002 = 5,860,533,168 ST2000DM001 = 3,907,029,168 ST2000DM002 = 3,907,029,168 ST1500DM003 = 2,930,277,168 ST1000DM003 = 1,953,525,168 ST1000DM004 = 1,953,525,168 ST750DM003 = 1,465,149,168 ST500DM002 = 976,773,168 ST320DM000 = 625,142,448 ST250DM000 = 488,397,168
104–107	ATA-reserved	0000 _H
108–111	The mandatory value of the world wide name (WWN) for the drive. NOTE: This field is valid if word 84, bit 8 is set to 1 indicating 64-bit WWN support.	Each drive will have a unique value.
112–127	ATA-reserved	0000 _H
128	Security status	0001 _H
129–159	Seagate-reserved	xxxx _H
160–254	ATA-reserved	0000 _H
255	Integrity word	xxA5 _H

Advanced Power Management (APM) and Automatic Acoustic Management (AAM) features are not supported.

See the bit descriptions below for words 63, 84, and 88 of the Identify Drive data.

Description (if bit is set to 1)		
	Bit	Word 63
	0	Multiword DMA mode 0 is supported.
	1	Multiword DMA mode 1 is supported.
	2	Multiword DMA mode 2 is supported.
	8	Multiword DMA mode 0 is currently active.
	9	Multiword DMA mode 1 is currently active.
	10	Multiword DMA mode 2 is currently active.
	Bit	Word 84
	0	SMART error login is supported.
	1	SMART self-test is supported.
	2	Media serial number is supported.
	3	Media Card Pass Through Command feature set is supported.
	4	Streaming feature set is supported.
	5	GPL feature set is supported.

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	6	WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported.
	7	WRITE DMA QUEUED FUA EXT command is supported.
	8	64-bit World Wide Name is supported.
	9-10	Obsolete.
	11-12	Reserved for TLC.
	13	IDLE IMMEDIATE command with IUNLOAD feature is supported.
	14	Shall be set to 1.
	15	Shall be cleared to 0.
	Bit	Word 88
	0	Ultra DMA mode 0 is supported.
	1	Ultra DMA mode 1 is supported.
	2	Ultra DMA mode 2 is supported.
	3	Ultra DMA mode 3 is supported.
	4	Ultra DMA mode 4 is supported.
	5	Ultra DMA mode 5 is supported.
	6	Ultra DMA mode 6 is supported.
	8	Ultra DMA mode 0 is currently active.
	9	Ultra DMA mode 1 is currently active.
	10	Ultra DMA mode 2 is currently active.
	11	Ultra DMA mode 3 is currently active.
	12	Ultra DMA mode 4 is currently active.
	13	Ultra DMA mode 5 is currently active.
	14	Ultra DMA mode 6 is currently active.

5.3.2 Set Features command

This command controls the implementation of various features that the drive supports. When the drive receives this command, it sets BSY, checks the contents of the Features register, clears BSY and generates an interrupt. If the value in the register does not represent a feature that the drive supports, the command is aborted. Power-on default has the read look-ahead and write caching features enabled. The acceptable values for the Features register are defined as follows:

Table 12 Set Features command

02 _H	Enable write cache (<i>default</i>).
03 _H	Set transfer mode (based on value in Sector Count register). Sector Count register values:
00 _H	Set PIO mode to default (PIO mode 2).
01 _H	Set PIO mode to default and disable IORDY (PIO mode 2).
08 _H	PIO mode 0
09 _H	PIO mode 1
0A _H	PIO mode 2
0B _H	PIO mode 3
0C _H	PIO mode 4 (<i>default</i>)
20 _H	Multiword DMA mode 0
21 _H	Multiword DMA mode 1
22 _H	Multiword DMA mode 2
40 _H	Ultra DMA mode 0
41 _H	Ultra DMA mode 1
42 _H	Ultra DMA mode 2
43 _H	Ultra DMA mode 3
44 _H	Ultra DMA mode 4
45 _H	Ultra DMA mode 5
46 _H	Ultra DMA mode 6
10 _H	Enable use of SATA features
55 _H	Disable read look-ahead (read cache) feature.
82 _H	Disable write cache
90 _H	Disable use of SATA features
AA _H	Enable read look-ahead (read cache) feature (<i>default</i>).
F1 _H	Report full capacity available

At power-on, or after a hardware or software reset, the default values of the features are as indicated above.

5.3.3 S.M.A.R.T. commands

S.M.A.R.T. provides near-term failure prediction for disk drives. When S.M.A.R.T. is enabled, the drive monitors predetermined drive attributes that are susceptible to degradation over time. If self-monitoring determines that a failure is likely, S.M.A.R.T. makes a status report available to the host. Not all failures are predictable. S.M.A.R.T. predictability is limited to the attributes the drive can monitor. For more information on S.M.A.R.T. commands and implementation, see the *Draft ATA-5 Standard*.

SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for D4_H) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: <http://seatools.seagate.com>.

This drive is shipped with S.M.A.R.T. features disabled. Users must have a recent BIOS or software package that supports S.M.A.R.T. to enable this feature. The table below shows the S.M.A.R.T. command codes that the drive uses.

Table 13 S.M.A.R.T. commands

Code in features register	S.M.A.R.T. command
D0 _H	S.M.A.R.T. Read Data
D2 _H	S.M.A.R.T. Enable/Disable Attribute Autosave
D3 _H	S.M.A.R.T. Save Attribute Values
D4 _H	S.M.A.R.T. Execute Off-line Immediate (runs DST)
D5 _H	S.M.A.R.T. Read Log Sector
D6 _H	S.M.A.R.T. Write Log Sector
D8 _H	S.M.A.R.T. Enable Operations
D9 _H	S.M.A.R.T. Disable Operations
DA _H	S.M.A.R.T. Return Status

If an appropriate code is not written to the Features Register, the command is aborted and 0x04 (abort) is written to the Error register.



Seagate Technology LLC

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EXHIBIT 8

GLEN ALMGREN-30(b)(6)

UNITED STATES DISTRICT COURT NORTHERN DISTRICT OF
CALIFORNIA SAN JOSE DIVISION

CASE NO. 5:16-cv-00523-RMW

30(b)(6) DEPOSITION OF SEAGATE July 26, 2017
TECHNOLOGY, LLC BY GLEN ALMGREN

IN RE SEAGATE TECHNOLOGY, LLC LITIGATION

APPEARANCES:

AXLER GOLDICH, LLC
By Marc A. Goldich, Esq.
and
Matthew Strout, Esq.
1520 Locust Street, Suite 301
Philadelphia, Pennsylvania 19102
Appearing on behalf of Plaintiffs.

SHEPPARD, MULLIN, RICHTER & HAMPTON, LLP
By Anna S. McLean, Esq.
and
Mukund Sharma, Esq.
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Appearing on behalf Defendants.

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GLEN ALMGREN-30(b)(6)

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1 Q What's the difference between an internal
2 bare drive and let's say an external drive?

3 A The -- the difference in the drive is --
4 there's really -- other than the external drive, it's
5 exactly that. It comes in a box, and it's branded
6 with Seagate. You know, it's the external box that
7 you could plug into your PC versus an internal drive
8 that you would plug directly into the inside of your
9 computer.

10 Q Gotcha. Same drive, but one gets placed
11 inside the hardware of the computer, and the other
12 gets plugged in via a cable, right?

13 A Yeah, and it's enclosed in an actual
14 enclosure.

15 Q And the Seagate logo?

16 A With the Seagate logo and other
17 electronics in that to talk via USB versus talking
18 via a standpoint port, which is what would be plugged
19 into the actual computer.

20 Q Understood. The ST3 marked as Barracuda
21 was one of these internal drives that would be placed
22 inside the computer, correct?

23 A Correct.

24 Q Okay. And ST300000, it was a 3 terabyte

GLEN ALMGREN-30(b)(6)

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1 configuration, correct?

2 A Correct.

3 Q Now, was the ST3000DM001 ever sold under
4 any other name other than Barracuda?

5 MS. MCLEAN: Object to the extent it goes
6 beyond the scope of his testimony. You can answer,
7 if you know.

8 A It -- it would have been sold as -- in an
9 external box under a different name, but that's
10 because it's the overall box, like a backup.

11 Q (By Mr. Goldich) Okay. Were there any
12 other internal drives with the ST3 model number that
13 were not marketed as Barracuda, but marketed with a
14 different name?

15 MS. MCLEAN: Same objection.

16 A Of the ST3000DM model number?

17 Q (By Mr. Goldich) Yes.

18 A Not that I'm aware of, not with that model
19 number.

20 Q Are you aware if the Desktop HDD was an
21 internal drive with that model number?

22 A Yeah. That is probably correct. It's the
23 same drive, but there was a market change to the
24 external names to be from Barracuda to what you said.

GLEN ALMGREN-30(b)(6)

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1 It would have been a marketing name. You're right.

2 Q So at some point, there was a marketing
3 name change from Barracuda to Desktop HDD?

4 MS. MCLEAN: I'll object to the extent
5 it's outside the scope of his testimony. Answer to
6 your personal knowledge.

7 A Yes. You're correct. There was a
8 marketing change to the external name.

9 Q (By Mr. Goldich) Do you know, based on
10 your personal knowledge right now, when that
11 occurred?

12 A I do not recall.

13 Q Okay. Is it your understanding that was a
14 marketing change, you said?

15 A Correct.

16 Q Do you know the reason for that marketing
17 change?

18 MS. MCLEAN: Same objection. Goes beyond
19 the scope. Answer to your personal knowledge.

20 A I do not know why.

21 Q (By Mr. Goldich) Has Seagate ever sold
22 the drives directly to consumers?

23 MS. MCLEAN: Same objection. By the
24 drives, are you referring to the Barracuda?

GLEN ALMGREN-30(b)(6)

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1 Q Okay. Prior to meeting with your counsel,
2 were you aware of the language change in the product
3 manual?

4 A I recall there being some discussions on
5 that, but at the time, I didn't remember until
6 yesterday.

7 Q Were you involved in discussions regarding
8 the change?

9 A I don't remember if I was involved in
10 discussions regarding that change. I don't remember.

11 Q Now, this product manual is for customers
12 who want to know about the product that they
13 purchased, right?

14 MS. MCLEAN: Objection. Vague, lacks
15 foundation.

16 A Yes.

17 Q (By Mr. Goldich) You can put that aside.

18 MR. GOLDICH: This will be Exhibit 11.

19 (Exhibit 11 marked.)

20 Q (By Mr. Goldich) So this is Exhibit 11,
21 and it is a product manual titled Seagate Desktop.
22 Do you see that?

23 A Yes.

24 Q At it says, "Formerly Barracuda 7200.14."

GLEN ALMGREN-30(b)(6)

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1 Do you see that?

2 A Yes.

3 Q So this is the drive that was formerly --
4 that was the drive for the product manual that we
5 just looked at, right?

6 MS. MCLEAN: Objection. Vague,
7 mischaracterizes the previous document.

8 Q (By Mr. Goldich) The previous document
9 was a product manual for the Barracuda, right?

10 A Yes, it was.

11 Q And this one says it's a product manual
12 for a Seagate Desktop HDD, which was formerly the
13 Barracuda, right?

14 A Correct. Formerly Barracuda 7200.14. I
15 don't know what this -- the previous document, if it
16 was .14 or not. I don't know.

17 Q Okay. We discussed earlier in the
18 deposition, you recall a change in the Barracuda name
19 from Barracuda to Desktop HDD, right?

20 A Correct.

21 Q Can you turn to 3847, please? So this is
22 a similar drive specification summary for the 3
23 terabyte ST3000DM001, correct?

24 A Correct.

EXHIBIT 9

CONFIDENTIAL

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10 Attorneys for Defendant
 SEAGATE TECHNOLOGY, LLC

11
 12 UNITED STATES DISTRICT COURT
 13 NORTHERN DISTRICT OF CALIFORNIA
 14

15 IN RE SEAGATE TECHNOLOGY, LLC
 LITIGATION

Case No. 5:16-cv-00523-JCS

16
 17 CONSOLIDATED ACTION

**SEAGATE TECHNOLOGY, LLC'S
 THIRD AMENDED RESPONSE TO
 PLAINTIFFS' FIRST SET OF
 INTERROGATORIES, NOS. 9 AND 10**

18
 19 PROPOUNDING PARTY: PLAINTIFFS CHRISTOPHER NELSON, DENNIS
 20 CRAWFORD, JOSHUAH ENDERS, DAVID SCHECHNER,
 21 CHADWICK HAUFF, JAMES HAGEY, NIKOLAS MANAK,
 AND DUDLEY LANE DORTCH IV

22 RESPONDING PARTY: DEFENDANT SEAGATE TECHNOLOGY, LLC

23 SET NO.: ONE (INTERROGATORY NOS. 9 AND 10)
 24
 25
 26
 27
 28

Case No. 5:16-cv-00523-JCS

CONFIDENTIAL

Defendant Seagate Technology LLC ("Seagate") hereby amends its response to the First Set of Interrogatories, Nos. 9 and 10, propounded by Plaintiffs Christopher Nelson, Dennis Crawford, Joshua Enders, David Schechner, Chadwick Hauff, James Hagey, Nikolas Manak, and Dudley Lane Dortch IV (collectively "Plaintiffs"). Seagate served responses to Plaintiffs' First Set of Interrogatories on the following dates: (1) Interrogatory No. 9 on December 28, 2016; (2) a corrected response to Interrogatory No. 9 on December 29, 2016; (3) responses to all remaining Interrogatories on February 13, 2017; (4) an amended response to Interrogatories Nos. 9 and 10 on May 22, 2017; and (5) a second amended response to Interrogatories Nos. 9 and 10 on August 9, 2017. The General Statement, General Objections, and Objections to Definitions set forth in Seagate's prior responses to Plaintiffs' First Set of Interrogatories are incorporated by reference as if set forth fully herein.

RESPONSES TO INTERROGATORIES NOS. 9 AND 10

INTERROGATORY NO. 9:

Identify and provide any and all names for the Hard Drives other than those stated in the Second Amended Complaint that you used at any time, internally or externally, to refer to the Hard Drives, including code or project names or identifiers, whether in word or numeric format.

CORRECTED RESPONSE TO INTERROGATORY NO. 9:

Seagate incorporates the General Objections set forth above. Subject to and without waiving the foregoing objections, Seagate responds as follows:

Product Code Name	Marketing Product Name	Bare Drive Model Number
Grenada	Barracuda	ST3000DM001
Grenada BP	Barracuda	ST3000DM001
Grenada BP PL	Barracuda	ST3000DM001
Grenada BP 2	Barracuda	ST3000DM001

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Stratus	BackUp Plus Mac	ST3000DM001
Stratus	BackUp Plus Desk	ST3000DM001
Udon	BackUp Plus Mac	ST3000DM001
Udon	BackUp Plus Desk	ST3000DM001
Rockit Desk	Free Agent GoFlex Desk	ST3000DM001
Rockit Desk	GoFlex Desk for Mac	ST3000DM001
Bronson	GoFlex Cinema	ST3000DM001
Explorer	Free Agent Go Flex Home	ST3000DM001

AMENDED RESPONSE INTERROGATORY NO. 9:

Seagate incorporates the General Objections set forth above. Subject to and without waiving the foregoing objections, Seagate responds as follows:

Product Code Name	Marketing Product Name	Bare Drive Model Number
Retail Kit	Desktop HDD Internal Kit	ST3000DM001
Grenada	Barracuda	ST3000DM001
Grenada BP	Barracuda	ST3000DM001
Grenada BP PL	Barracuda	ST3000DM001
Grenada BP 2	Barracuda	ST3000DM001
Stratus	BackUp Plus Mac	ST3000DM001
Stratus	BackUp Plus Desk	ST3000DM001
Udon	BackUp Plus Mac	ST3000DM001
Udon	BackUp Plus Desk	ST3000DM001
Rockit Desk	Free Agent GoFlex Desk	ST3000DM001
Rockit Desk	GoFlex Desk for Mac	ST3000DM001

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Explorer	Free Agent Go Flex Home	ST3000DM001
----------	-------------------------	-------------

SECOND AMENDED RESPONSE TO INTERROGATORY NO. 9:

Seagate incorporates the General Objections set forth above. Subject to and without waiving the foregoing objections, Seagate responds as follows:

Product Code Name	Marketing Product Name	Bare Drive Model Number
Retail Kit	Desktop HDD Internal Kit	ST3000DM001
Raptor	Desktop External Drive	ST3000DM001
Grenada	Barracuda	ST3000DM001
Grenada BP	Barracuda	ST3000DM001
Grenada BP PL	Barracuda	ST3000DM001
Grenada BP 2	Barracuda	ST3000DM001
Stratus	BackUp Plus Mac	ST3000DM001
Stratus	BackUp Plus Desk	ST3000DM001
Udon	BackUp Plus Mac	ST3000DM001
Udon	BackUp Plus Desk	ST3000DM001
Rockit Desk	FreeAgent GoFlex Desk	ST3000DM001
Rockit Desk	GoFlex Desk for Mac	ST3000DM001
Explorer	FreeAgent GoFlex Home	ST3000DM001
Falcon Desk	Expansion Desk	ST3000DM001
Sake	Expansion Desk Plus	ST3000DM001
Sentinel	Business 1 BAY NAS	ST3000DM001
Half Dome	Business 2 BAY NAS	ST3000DM001
El Capitan	Business 4 BAY NAS	ST3000DM001

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THIRD AMENDED RESPONSE TO INTERROGATORY NO. 9:

Seagate incorporates the General Objections set forth above. Subject to and without waiving the foregoing objections, Seagate responds as follows:

Product Code Name	Marketing Product Name	Bare Drive Model Number
Retail Kit	Desktop HDD Internal Kit	ST3000DM001
Raptor	Desktop External Drive	ST3000DM001
Grenada	Barracuda	ST3000DM001
Grenada BP	Barracuda	ST3000DM001
Grenada BP PL	Barracuda	ST3000DM001
Grenada BP 2	Barracuda	ST3000DM001
Stratus	BackUp Plus Mac	ST3000DM001
Stratus	BackUp Plus Desk	ST3000DM001
Udon	BackUp Plus Mac	ST3000DM001
Udon	BackUp Plus Desk	ST3000DM001
Rocket Desk	FreeAgent GoFlex Desk	ST3000DM001
Rocket Desk	GoFlex Desk for Mac	ST3000DM001
Explorer	FreeAgent GoFlex Home	ST3000DM001
Falcon Desk	Expansion Desk	ST3000DM001
Raptor	Expansion Desk	ST3000DM001
Sake	Expansion Desk Plus	ST3000DM001
Sentinel	Business 1 BAY NAS	ST3000DM001
Half Dome	Business 2 BAY NAS	ST3000DM001
El Capitan	Business 4 BAY NAS	ST3000DM001

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INTERROGATORY NO. 10:

List the product name, internal project name/identifier, and model number for each and every external hard drive that you have sold to the public, directly or indirectly through a reseller, retailer, or other entity, that contains a model number ST3000DM001 hard drive on the inside, regardless of whether the external hard drive bears a different model number on its outer casing.

RESPONSE TO INTERROGATORY NO. 10:

Seagate incorporates the General Objections and Objections to Definitions set forth above. Subject to and without waiving the foregoing objections, Seagate responds as follows:

Seagate hereby incorporates its December 29, 2016 Response to Interrogatory No. 9 as if set forth fully herein.

AMENDED RESPONSE TO INTERROGATORY NO. 10:

Seagate incorporates the General Objections set forth above. Subject to and without waiving the foregoing objections, Seagate responds as follows:

Product Name	External ST Model Number
Desktop HDD Internal Kit	STBD3000100
Backup Plus Mac	STCB3000100
	STCB3000400
	STCB3000401
	STCB3000900
	STCB3000901
	STDU3000101
Backup Plus Desk	STCA3000101
	STCA3000600
	STCA3000601
	STCA3000602
	STDT3000100

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	STDT3000600
	STFM3000100
FreeAgent GoFlex Desk	STAC3000100
	STAC3000102
	STAC3000404
	STAC3000602
FreeAgent GoFlex Home	STAM3000100
GoFlex Desk for Mac	STBC3000101
	STBC3000102

SECOND AMENDED RESPONSE TO INTERROGATORY NO. 10:

Seagate incorporates the General Objections set forth above. Subject to and without waiving the foregoing objections, Seagate responds as follows:

Product Name	Box ST Model Number(s)	Chassis ST Model Number(s)
Desktop HDD Internal Kit	STBD3000100	N/A
Backup Plus Desk	STCA3000101	STDT3000400
	STCA3000600	STDT3000402
	STCA3000601	STFM3000400
	STCA3000602	
	STDT3000100	
	STDT3000600	
	STFM3000100	
Backup Plus Mac	STCB3000100	STCB3000201
	STCB3000400	STCB3000101
	STCB3000401	STDU3000400
	STCB3000900	

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	STCB3000901	
	STDU3000101	
Seagate Expansion Desk	STBV3000100	STEB3000400
	STBV3000200	
	STEB3000100	
	STEB3000200	
Seagate Expansion Desk Plus	STEG3000100	STCP3000400
	STCP3000100	STEG3000400
Desktop External Drive	STAY3000100	N/A
	STAY3000102	
GoFlex Desk for Mac	STBC3000101	N/A
	STBC3000102	
FreeAgent GoFlex Home	STAM3000100	STAM3000400
FreeAgent GoFlex Desk	STAC3000100	STAC3000402
	STAC3000102	STAC3000202
	STAC3000602	STAC3000403
	STAC3000404	
Barracuda	N/A	N/A
Business 1 BAY NAS	STBM3000100	N/A
Business 2 BAY NAS	STBN6000100	N/A
Business 4 BAY NAS	STBP12000100	N/A

THIRD AMENDED RESPONSE TO INTERROGATORY NO. 10:

Seagate incorporates the General Objections set forth above. Subject to and without waiving the foregoing objections, Seagate responds as follows:

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Product Name	Box ST Model Number(s)	Chassis ST Model Number(s)
Desktop HDD Internal Kit	STBD3000100	N/A
Backup Plus Desk	STCA3000101	STDT3000400
	STCA3000600	STDT3000402
	STCA3000601	STFM3000400
	STCA3000602	
	STDT3000100	
	STDT3000600	
	STFM3000100	
Backup Plus Mac	STCB3000100	STCB3000201
	STCB3000400	STCB3000101
	STCB3000401	STDU3000400
	STCB3000900	
	STCB3000901	
	STDU3000101	
Seagate Expansion Desk	STBV3000100	STEB3000400
	STBV3000200	
	STEB3000100	
	STEB3000200	
	STAY3000100	
	STAY3000102	
Seagate Expansion Desk Plus	STEG3000100	STCP3000400
	STCP3000100	STEG3000400
GoFlex Desk for Mac	STBC3000101	N/A
	STBC3000102	

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FreeAgent GoFlex Home	STAM3000100	STAM3000400
FreeAgent GoFlex Desk	STAC3000100	STAC3000402
	STAC3000102	STAC3000202
	STAC3000602	STAC3000403
	STAC3000404	
Barracuda	N/A	N/A
Business 1 BAY NAS	STBM3000100	N/A
Business 2 BAY NAS	STBN6000100	N/A
Business 4 BAY NAS	STBP12000100	N/A

Dated: February 8, 2018

SHEPPARD, MULLIN, RICHTER & HAMPTON LLP

By /s/ Anna S. McLean
ANNA S. McLEAN

Attorneys for Defendant
SEAGATE TECHNOLOGY, LLC

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PROOF OF SERVICE
In re Seagate Technology LLC Litigation
USDC Case No. 5:16-cv-00523-JCS

I am over eighteen years old, not a party to the within action, and made the following service from my place of employment—Sheppard, Mullin, Richter & Hampton, Four Embarcadero Center, 17th Floor, San Francisco CA 94111.

On February 8, 2018, I served the following document:

SEAGATE TECHNOLOGY, LLC'S THIRD AMENDED RESPONSE TO PLAINTIFFS' FIRST SET OF INTERROGATORIES, NOS. 9 AND 10

in pdf format from my email address (ewilson@sheppardmullin.com) to the persons at the email addresses listed below:

- **Steve W. Berman**
steve@hbsslaw.com; heatherw@hbsslaw.com; nicolleg@hbsslaw.com;
josephs@hbsslaw.com;
- **Jeff D Friedman**
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I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct. Executed on February 8, 2018, at San Francisco, California.

/s/ Eileen M. Wilson

Eileen M. Wilson

EXHIBIT 10

PATRICK DEWEY 30(b)(6)

Page 1

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
No. 5:16-cv-00523-RMW

30(b)(6) DEPOSITION OF SEAGATE TECHNOLOGY, LLC
AS GIVEN BY: PATRICK DEWEY
September 7, 2017

IN RE SEAGATE TECHNOLOGY, LLC
LITIGATION

APPEARANCES:

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SHEPPARD MULLIN

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Appearing on behalf of Seagate
Technology, LLC

PATRICK DEWEY 30(b)(6)

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1 of spec, there was internal approval to ship the
2 document -- or to ship the disk for SBS, right?

3 A Yes. The approval came from SBS.

4 Q And it was the approval to ship the drives
5 to Seagate Branded Solutions consumers, right?

6 A Yes.

7 Q Okay. I'd like to mark Exhibit 9.
8 (Exhibit 9 marked.)

9 Q (BY MR. GOLDICH) Now, this is entitled
10 "Grenada BP ECQ Approved Final," dated June 5th,
11 2012, correct?

12 A Yes.

13 Q Okay. Are you familiar with this
14 document?

15 A Yes, I am.

16 Q Okay. When have you seen it before?

17 A During generation review.

18 Q Okay. This is a document that you
19 drafted?

20 A Yes.

21 Q Okay. What is an ECQ approved final?

22 A ECQ is an engineering change
23 qualification. So rather than a brand-new design,
24 new capacity drive, this is deemed to be -- we're
25 trying to demonstrate equivalency with the changes

PATRICK DEWEY 30(b)(6)

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1 for the product. And so that does not require you to
2 go through the full step of the PLP life cycle test
3 process. You can start as early as Gen 1 and skip
4 some of the engineering models and the Phase 0
5 contracts, and you introduce the changes and verify
6 that they're acceptable, and then approve for
7 shipment.

8 Q And that's for the Grenada BP, right?

9 A Yes, sir.

10 Q Okay. And so this is -- this is more than
11 a year after the Grenada Classic was approved for
12 shipment to SBS, right?

13 A Correct.

14 Q Okay. Okay. Can you turn to 26781,
15 please.

16 A Yes.

17 Q Okay. This page is titled "Grenada Base -
18 DSP Interference," right?

19 A Yes.

20 Q What's that a reference to?

21 A Within multidisk, HDAs, between the disks
22 we use what is called a separator plate, and the
23 separator plate reduces the windage turbulence from
24 the disk rotating and then closure. And so what that
25 does is reduce the mechanical motion in operation of

EXHIBIT 11

CONFIDENTIAL

1 SHEPPARD, MULLIN, RICHTER & HAMPTON LLP
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 2 Including Professional Corporations
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12 UNITED STATES DISTRICT COURT
 13 NORTHERN DISTRICT OF CALIFORNIA
 14

15 IN RE SEAGATE TECHNOLOGY, LLC
 LITIGATION
 16

Case No. 5:16-cv-00523-JCS

17 CONSOLIDATED ACTION
 18

**DEFENDANT SEAGATE
 TECHNOLOGY, LLC'S RESPONSES TO
 PLAINTIFF CHRISTOPHER NELSON'S
 SECOND SET OF INTERROGATORIES**

19 PROPOUNDING PARTY: PLAINTIFF CHRISTOPHER NELSON
 20

21 RESPONDING PARTY: DEFENDANT SEAGATE TECHNOLOGY, LLC
 22

23 SET NO.: TWO
 24
 25
 26
 27
 28

CONFIDENTIAL

1 Defendant Seagate Technology LLC (“Seagate”) hereby responds and objects to the
2 Second Set of Interrogatories propounded by Plaintiff Christopher Nelson (“Plaintiff”).

3 **GENERAL STATEMENT AND OBJECTIONS**

4 1. The following responses are made solely for purposes of this action. Each response
5 is subject to all objections as to competence, relevance, materiality, propriety and admissibility,
6 and any and all other objections and grounds which would require the exclusion of any statements
7 contained herein, if such statements were made by a witness present and testifying at court, all of
8 which objections and grounds are reserved and may interposed at the time of trial.

9 2. The following responses are based upon information presently available to Seagate.
10 Seagate is not making any incidental or implied admissions regarding the contents of these
11 responses. Seagate’s objections, and any subsequent responses, are at all times subject to such
12 additional or different information as may result from further discovery, investigation, and/or
13 refreshing of recollection. Seagate reserves the right to alter, amend, or supplement any responses
14 it makes to Plaintiff Christopher Nelson’s Second Set of Interrogatories. Seagate reserves the
15 right to make any use of, or to introduce at any hearing and at trial, information responsive to the
16 Second Set of Interrogatories, but discovered subsequent to the date of any responses to the
17 Second Set of Interrogatories, including, but not limited to, any such information obtained in
18 discovery herein. The fact that Seagate has answered part or all of any of the following
19 Interrogatories is not intended and shall not be construed to be a waiver by Seagate of all or any
20 part of any objections to any Interrogatory.

21 3. Seagate objects to each and every Interrogatory on the ground that Plaintiff failed
22 to provide sufficient time for Seagate to investigate and provide a response to same, despite
23 Seagate’s multiple requests for additional time.

24 4. Seagate objects to each and every Interrogatory to the extent they seek information
25 outside the possession, custody, or control of Seagate and that is not within Seagate’s personal
26 knowledge.

27 5. Seagate objects to each Interrogatory to the extent that it seeks information subject
28 to the attorney-client privilege, the attorney work product doctrine, or any other applicable

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1 privilege or limitation on discovery. In responding to these Interrogatories, Defendant will not
2 provide any information protected from disclosure pursuant to any applicable privileges and
3 limitations on discovery.

4 6. Seagate objects to each Interrogatory to the extent that it seeks to discover
5 confidential, proprietary, commercial, trade secret, or any other sensitive information, the
6 disclosure of which could be damaging to Seagate or any other related business entities. Seagate
7 will respond regarding any responsive information pursuant to the Protective Order entered in this
8 action.

9 7. Seagate objects to each Interrogatory to the extent that it is vague and ambiguous.

10 8. Seagate objects to each Interrogatory to the extent it is unduly burdensome, and to
11 the extent it purports to impose duties on Seagate beyond those required by the Federal Rules of
12 Civil Procedure.

13 **OBJECTIONS TO DEFINITIONS**

14 1. Seagate objects to the definition of “YOU” and “YOUR” as overbroad to the extent
15 Plaintiffs purport to define Seagate as including “its predecessors, successors, subsidiaries,
16 departments, divisions, joint ventures and/or affiliates, including, without limitation, any
17 organization or entity which the responding party manages or controls, together with all present
18 and former directors, officers, employees, agents, representatives or any persons acting or
19 purporting to act on behalf of the responding party. ” Seagate will answer these document
20 requests only on behalf of Seagate Technology LLC.

21 **RESPONSES TO INTERROGATORIES**

22 **INTERROGATORY NO. 11:**

23 Identify all part numbers for the Barracuda 3TB Internal Hard Disk Drive (model number
24 ST3000DM001), the 3TB Desktop HDD (model number ST3000DM001), and the 3TB
25 Barracuda/Desktop HDD Internal Kit (with a model number including, but not necessarily limited
26 to, STBD3000100), that were manufactured during the Class Period and sold through any channel
27 except the OEM channel. For each part number, please identify the month and year the Drive was
28 first introduced in commerce.

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RESPONSE TO INTERROGATORY NO. 11:

Seagate incorporates the General Objections set forth above. Seagate further objects to this Interrogatory on the grounds that it is vague and ambiguous, especially as to the terms “part numbers,” “Class Period,” “any channel,” and “introduced in commerce,” which are undefined. Seagate’s response is limited to the time period January 1, 2011—present. Seagate further objects to this Interrogatory on the grounds that it seeks information outside the scope of this litigation, as it encompasses parts and drives sold to non-class members. Seagate further objects to this Interrogatory on grounds that it is compound in violation of Federal Rule of Civil Procedure 33(a)(1), and, in combination with Plaintiffs’ prior compound interrogatories, exceeds the maximum number of permitted interrogatories. *Rambus Inc. v. NVIDIA Corp.*, 2011 U.S. Dist. LEXIS 156378, 2011 WL 11746749, at *14 (N.D. Cal. Aug. 24, 2011) (“[a]n interrogatory that seeks information (even a single piece of information) about 300 separate products is asking 300 separate questions.”); *Stamps.com, Inc. v. Endicia Sys.*, 2008 U.S. Dist. LEXIS 112633, *10 (C.D. Cal. May 21, 2008) (same); *Collaboration Props. v. Polycom, Inc.*, 224 F.R.D. 473, 475 (N.D. Cal. 2004) (holding that where each interrogatory sought information about all of the accused products (totaling 26 different products), each interrogatory had 26 discrete subparts). Finally, Seagate objects to this Interrogatory as unduly burdensome, compound, duplicative, and harassing as it seeks information similar to that already provided in response to Plaintiffs’ First Set of Interrogatories, specifically, Interrogatories 9 and 10, but with a level of detail requiring an undue amount of time to investigate and respond.

Subject to and without waiving the foregoing objections, Seagate responds as follows: Seagate will continue to investigate this issue and will provide Plaintiff with a supplemental response as soon as reasonably possible.

INTERROGATORY NO. 12:

For each part number identified in Interrogatory No. 11, please state the unit sales and total annual revenue, by year, from sales within the United States.

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RESPONSE TO INTERROGATORY NO. 12:

Seagate incorporates the General Objections set forth above. Seagate further objects to this Interrogatory on the grounds that it is vague and ambiguous, especially as to the terms “part numbers,” “Class Period,” and “introduced in commerce,” which are undefined. Seagate’s response is limited to the time period January 1, 2011—present. Seagate further objects to this Interrogatory on the grounds that it seeks information outside the scope of this litigation, as it encompasses parts and drives sold to non-class members. Seagate additionally objects to this Interrogatory on the ground that Plaintiff failed to provide sufficient time for Seagate to investigate and provide a response to same, despite Seagate’s multiple requests for additional time. Seagate further objects to this Interrogatory on grounds that it is compound in violation of Federal Rule of Civil Procedure 33(a)(1), and, in combination with Plaintiffs’ prior compound interrogatories, exceeds the maximum number of permitted interrogatories. *Rambus Inc. v. NVIDIA Corp.*, 2011 U.S. Dist. LEXIS 156378, 2011 WL 11746749, at *14 (N.D. Cal. Aug. 24, 2011) (“[a]n interrogatory that seeks information (even a single piece of information) about 300 separate products is asking 300 separate questions.”); *Stamps.com, Inc. v. Endicia Sys.*, 2008 U.S. Dist. LEXIS 112633, *10 (C.D. Cal. May 21, 2008) (same); *Collaboration Props. v. Polycom, Inc.*, 224 F.R.D. 473, 475 (N.D. Cal. 2004) (holding that where each interrogatory sought information about all of the accused products (totaling 26 different products), each interrogatory had 26 discrete subparts). Finally, Seagate objects to this Interrogatory as unduly burdensome, compound, duplicative, and harassing as it seeks the same information already provided to Plaintiffs in response to the First Set of Nelson Interrogatories, specifically, Interrogatories 2 and 3.

Subject to and without waiving the foregoing objections, Seagate responds as follows: Seagate will continue to investigate this issue and will provide Plaintiff with a supplemental response as soon as reasonably possible.

INTERROGATORY NO. 13:

State whether 3TB Barracuda/Desktop HDD Internal Kits (with a model number including, but not necessarily limited to, STBD3000100), that were manufactured during the Class Period

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1 and sold through any channel except the OEM channel, were classified as distribution (or “disty”)
2 drives or Seagate Branded Solutions (or “SBS”) drives for the purposes of AFR testing.

3 **RESPONSE TO INTERROGATORY NO. 13:**

4 Seagate incorporates the General Objections set forth above. Seagate further objects to this
5 Interrogatory on the grounds that it is vague and ambiguous, especially as to the terms “Class
6 Period,” “OEM channel,” and “AFR testing,” which are undefined. Seagate’s response is limited
7 to the time period January 1, 2011—present. Seagate further objects to this Interrogatory on the
8 grounds that it seeks information outside the scope of this litigation, as it encompasses parts and
9 drives sold to non-class members. Seagate additionally objects to this Interrogatory on the ground
10 that Plaintiff failed to provide sufficient time for Seagate to investigate and provide a response to
11 same, despite Seagate’s multiple requests for additional time. Finally, Seagate objects to this
12 Interrogatory as unduly burdensome, compound, duplicative, and harassing as it seeks the same
13 information already provided in the Declaration of Patrick Dewey.

14 Subject to and without waiving the foregoing objections, Seagate responds as follows:
15 Seagate will continue to investigate this issue and will provide Plaintiff with a supplemental
16 response as soon as reasonably possible.

17
18 Dated: October 5, 2018

19 SHEPPARD, MULLIN, RICHTER & HAMPTON LLP

20
21 By /s/ Anna S. McLean
22 Anna S. McLean

23 Attorneys for Defendant
24 SEAGATE TECHNOLOGY, LLC
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EXHIBIT 13



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1	Rating	Date	Name	Title	Verified Purchase	Vine
2	4	12/14/2012	Zach	Had for about 2 weeks	y	n
3	1	12/16/2012	gdog	Failed within 2 months	y	n
4	3	12/18/2012	Michael Shapiro	The drive did not mount under XP	y	n
5	4	12/21/2012	Joe	Great product!	y	n
6	1	12/21/2012	David Hoff	Absolute piece of garbage and Seagate is too	y	n
7	1	12/22/2012	dds!	Seagate Expansion doesn't work for me!	y	n
8	5	12/23/2012	iNad925	Excellent Product!	y	n
9	4	12/24/2012	Justin	Great hard drive	y	n
10	4	12/25/2012	George R. Hutman	hard drive	y	n
11	2	12/27/2012	Shepherd "Shepherd"	Really flimsy chassis	y	n
12	4	1/6/2013	Mavra	Undetected by my two PCs, required a two hours reformatting	y	n
13	1	1/7/2013	Ice	Dead after 2 days	y	n
14	1	1/9/2013	Jackie C.	Drive was faulty, now my files are being held hostage,	y	n

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1	Review Site	Model
2	http://www.amazon.com/review/RGVH9J39TOH72/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJSK&linkCode=&nodeID=&tag=	Expansion Portable
3	http://www.amazon.com/review/RFIVG5LVYT82M/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B008R7FC74&linkCode=&nodeID=&tag=	Expansion Portable
4	http://www.amazon.com/review/R1J1QVQ3PQN80Q/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B008R7FC74&linkCode=&nodeID=&tag=	Expansion Portable
5	http://www.amazon.com/review/R2Y6CGPSG73QZW/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B009T0FGRE&linkCode=&nodeID=&tag=	Expansion Portable
6	http://www.amazon.com/review/R15W5C9AX6YFND/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJSK&linkCode=&nodeID=&tag=	Expansion Portable
7	http://www.amazon.com/review/R3D8U116PBF9DY/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B008R7FC74&linkCode=&nodeID=&tag=	Expansion Portable
8	http://www.amazon.com/review/R3V6Z3NNZRZSO6/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B009T0FGRE&linkCode=&nodeID=&tag=	Expansion Portable
9	http://www.amazon.com/review/RLG56VY8RGXWF/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B009T0FGRE&linkCode=&nodeID=&tag=	Expansion Portable
10	http://www.amazon.com/review/RB32ZWGV3N4VQ/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJSK&linkCode=&nodeID=&tag=	Expansion Portable
11	http://www.amazon.com/review/R1Y96Z9NU1SR3M/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B008R7FC74&linkCode=&nodeID=&tag=	Expansion Portable
12	http://www.amazon.com/review/R1KBAEGVX0KUWW/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B008R7FC74&linkCode=&nodeID=&tag=	Expansion Portable
13	http://www.amazon.com/review/RVSGV0V5R33SA/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B008R7FC74&linkCode=&nodeID=&tag=	Expansion Portable
14	http://www.amazon.com/review/R2IXZ2HXQO0A56/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJSK&linkCode=&nodeID=&tag=	Expansion Portable

1	Comments
2	I personally like this product! It was super simple to get up and running i backed up my entire laptop on this also i put all my files on this and kept shortcuts on my laptop making a big difference in performance! Also its light only downfall is id like to have seen the shell of this aluminum or some grade so it doesn't feel so fragile, other then that i love it.
3	We used this as a backup for our photography business and it failed 2 months after we purchased it. We went online to Seagate's support page and did everything they said to get the computer to recognize the drive again and none of it worked. What's the point of having a backup if it's going to fail? We've also used Western Digital external hard drives and they fail, too. We're just going to start using online I was able to mount the drive and a driver was installed on a Window 7 machine and it seems to work just fine on this machine..
	However, the drive did "not" mount under Windows XP professional. The first time I plugged it in, XP did see and tried to find a driver on the drive and failed and would not mount the drive after that. I have not succeed in finding a driver for this drive and XP will not even see the drive any longer when I plug it in.
	The support site for this product does not address this issue. I have created a support ticket, but if I can't get the issue resolved, I will return the drive.

	The problem turned out to be the USB drivers/chipset. I had to work with the manufacturer of the XP machine. They were able to update the chipset and now the drive mounts just fine.
4	The only comment, then, about the drive, is that it did not come with any instructions about how to deal with this problem with XP. Seagate support was very responsive, but they stopped helping me when
5	It would have been 5* for fast transfer speed and useability, but the cable sometimes wiggles around and causes the HD to disconnect from the computer...this isn't a huge issue most of the time, but a
6	The drive failed me after 2 uses. I lost over 1000 photos. Seagate is horrible for customer service. The warranty sucks too. You can get another drive but why would you just to have it fail again. Data recovery is not covered and they offered to recover it for \$500 to \$1000. Are you freaking kidding me? DO NOT BUY THIS.
7	I have never gotten it to work on my computer oor my granddaughters. Several people who are very good at working on computers have not gotten it to work on my Windows 7 Home Premium, so far it was a
	Honestly, I would like to give this product a 4.5/5 but the system doesn't allow for that. Regardless, its quick, portable and extremely reliable so far; I have owned the hard drive for about 1 month.
8	Only drawback: it's a USB connection to the computer but the wire to the hard drive is NOT USB. It's some other port, so you can't ever use a substitute wire if you forget or misplace the wire that comes with the hard drive. Other than this, I have zero other issues with the product.
	Got this to load my games onto because my system has a bad SATA controller and kills or makes my SATA hard drives malfunction. The 10 year old PATA 80GB hard drive still works great for booting my OS but it was slow and obviously not capacious enough for games and heavy media. Runs my games better than my PATA drive would that's for sure.
9	The only flaw I have found is that it does not always turn on the interface of the drive when I plug it into the USB port. The drive will power on, but the blue activity light showing that it's picked up by the PC and active does not turn on and my PC doesn't recognize it immediately. However once I unplug it and plug it back in (sometimes several times before it finally takes) it works totally fine. No problems. Great
10	Seagate's install was easy to follow. Using the pictures did not help to use. Once I figured out how to use it the product was good. I right clicked to copy and then pasted on the seagate drive. The direction
	The hard drive itself is probably nice and reads/writes data without any hiccups, just not what holds it. I'm returning the drive.
	The chassis is really flimsy. The bottom part seems to be some sort of plastic material and doesn't fit with the enclosure (not sure if it's just the unit I got) When I pick it up the side close to the USB port, the bottom sinks in and makes a click sound -- as if I was clicking on a mouse. Note that I was just picking it up, not squeezing it. That kind of tactile feedback is actually quite nice, on a mouse button, that is. For an external USB drive that I'll be carrying around, it's worrisome.
11	The pictures on the product page make the hard drive look like a premium, solid, and durable product. I only wish the engineering of the chassis could reflect those qualities.
	And now it works perfectly. The seagate website troubleshooting process is user friendly. I followed the step by step guide and was able to use the drive. Not after 30 seconds as mentioned on the website but after 3 hours of troubleshooting and reformatting.
12	I do recommend this product, is small, light and sleek.
	After 2 days faint beeping sound,won't recognize.
	Don't have access to my data.
13	Seagate wants for recovery \$599.00 - \$1800.00+.
	I purchased this drive to back up my computer files prior to reformatting the drive and selected it primarily because of the positive consumer feedback. I was able to copy my files to the drive, but I have since been unable to access anything on the drive. I have contacted Seagate and they have admitted that it is a faulty drive, and while the drive is covered by warranty and they are willing to replace it, they stipulate that data recovery is not covered. I contacted the data recovery department, and they estimate that it will cost between \$600-1800 to access my files. This is highly frustrating because the reason I can't obtain the files is because they sold me a faulty product. Also, while they will replace my original drive, they require that I return the original one, which I am unwilling to do because I still want to try to recover the
14	

	J	K	L	M	N	O	P	Q	R	S	T	U
1	Issue or Feedback	Issue Tag	Issue Tag	Issue Tag	Issue Tag	Issue Tag	Issue Tag	Issue Tag	Issue Tag	Issue Tag	Issue Tag	
2	Feedback	case										
3	Issue	rma										
4	Issue	setup										
5	Issue	cable										
6	Issue	data loss	rma									
7	Issue	compatibility										
8	Feedback	connection										
9	Issue	on/off										
10	Issue	setup										
11	Feedback	case										
12	Issue	format										
13	Issue	noisy	data loss									
14	Issue	data loss										

	A	B	C	D	E	F
15	1	1/9/2013	Luke Deandrade "lukeap"	Problems with ejecting the drive from Windows 7	n	n
16	1	12/18/2012	Nazeer Halawani	Straight to garbage! don't waste your money	y	n
17	3	12/18/2012	Vincent F. Yankovitz	Returned	y	n
18	2	12/18/2012	M. Warenr	DOA	y	n
19	1	12/18/2012	Jason	HARD DRIVE SUCKS!	y	n
20	1	12/18/2012	Anthony Campo	3TB Drives are defective or are going to be	y	n
21	2	12/19/2012	Pablo F. Melendez	Noisy Adapter!	y	n
22	3	12/19/2012	A. Yang	Quality is not what I expected from Seagate anymore	y	n
23	1	12/21/2012	XM	Died after 1 week	y	n
24	1	12/21/2012	Catherine Deffley	Terrible Product	y	n
25	1	12/23/2012	Andrew	Doesn't Power On	y	n
26	2	12/24/2012	Wayne J. Courson	Drive died a Week Ago	y	n
27	1	12/24/2012	MontyPython	thought seagate was a good brand	y	n
28	3	12/25/2012	Cathiekl	Pretty Heavy	y	n
29	2	12/26/2012	Dustin Sallings	Doesn't work where I need it	y	n
30	2	12/26/2012	nishels	Noisy	y	n
31	4	12/26/2012	Kirk E. Morehead	External HD	y	n
32	1	12/26/2012	Andrew I. Schamess	Defective plug, poor workmanship	y	n
33	3	12/26/2012	Xavier B.	Good price, but some heavy...	y	n
34	4	12/28/2012	Minhyung Kim	perfect, but has heating problem	y	n
35	2	12/30/2012	akita	DVDs copied to this hard drive do not play in Windows Media Center	y	n
36	2	12/31/2012	Larry	Drops for drive listing	y	n
37	4	1/3/2013	Alexander Feinman	Noisy for an External	y	n
38	1	1/6/2013	MacJay	Keeps disconnecting from Time Capsule and MacBook Pro	y	n

	G	H
15	http://www.amazon.com/review/R1WK5BONY761FG/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B009T0FGRE&linkCode=&nodeID=&tag=	Expansion Portable
16	http://www.amazon.com/review/R174PKTC31MCTE/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
17	http://www.amazon.com/review/RPVUTZFJ5BECG/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
18	http://www.amazon.com/review/RKDYUL2PX1ZJ/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
19	http://www.amazon.com/review/R112QRVYKWLZ33/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
20	http://www.amazon.com/review/R3KXOAZUIKBT/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
21	http://www.amazon.com/review/R2YLA6UZNDXX/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
22	http://www.amazon.com/review/R38DWQQ4GFC9UM/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
23	http://www.amazon.com/review/R311XPTX067XJZ/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
24	http://www.amazon.com/review/R2LWBSI8DKSKXN/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJS0&linkCode=&nodeID=&tag=	Expansion Desktop
25	http://www.amazon.com/review/R2N312780TH3C3/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
26	http://www.amazon.com/review/R2GVJO6WQ7IPFT/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
27	http://www.amazon.com/review/R3GNMBN1SDTKK/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJS0&linkCode=&nodeID=&tag=	Expansion Desktop
28	http://www.amazon.com/review/R17VGL7FRIJG72/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
29	http://www.amazon.com/review/R1AFWUJCIZ1D41/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
30	http://www.amazon.com/review/R3R7D7X6U9FWM/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
31	http://www.amazon.com/review/R3GLRHB1TJQFNV/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
32	http://www.amazon.com/review/R1FNHUXWXDOB6I/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
33	http://www.amazon.com/review/R1XXQOZ4HGU0R1/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
34	http://www.amazon.com/review/R8OMUSPBJROOK/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
35	http://www.amazon.com/review/R21SHCTZ6UB5K7/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
36	http://www.amazon.com/review/R3BEY0MBKWVUYU/ref=cm_cr_rdp_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
37	http://www.amazon.com/review/RO0ALOBMRPF8H/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
38	http://www.amazon.com/review/R1YF4TFR5BSNBA/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJS0&linkCode=&nodeID=&tag=	Expansion Desktop

	This drive has worked fine for me so far except for one major flaw.
15	When you try to right click and eject the drive the eject option isn't present. It seems like this is a problem many people are having with this drive. So far I don't know what to do except turn the computer off so I just bought this hard and shipped it to lebanon. The drive was blank except for 2 applications. (1) Registration and (2) Setup.exe. Registration worked well but setup failed and always opens a new window showing my Documents (I use Win7)
16	I decided to test it by copying around 60GB of files on it, All photos and videos. 1-hour later I discover the drive is faulty. Instead of showing the folder I copied, it is showing me "My Documents", and when clicked, it would take me to my documents folder as if all the files were on the seagate. I thought I might have copied the whole folder by mistake, but no. On my colleague's laptop the "My Documents" folder took us to HIS documents, as if they were installed on the drive.
17	Returned as it wouldn't work on windows 7, it was too much memory am looking for a smaller one as of now.
18	The Only reason I didn't just give it one star was because Seagate is sending me a new one. Then I will update this review.
19	I was so excited on getting this hard drive as I am in Afghanistan and there are an abundance of movies and music circulating amongst us troops. I plugged it into my Windows 7 HP and it did not register or populate in my "MY COMPUTER" folder. I went into manage devices and it shows the hard drive as only having 3 GB. YES I said 3 GB rather than 3 TB. I must say that I bought mine refurbished and it cost
20	I should have read deeper into the reviews. I barely use this drive and it is almost never spinning in the 3 months I have had it. With that said, I am already getting Win 8 messages telling me to restart my PC so that it can repair the drive. None of my other drives have had a problem in the 2+ years I have had them (2 Sammys and a WVD). So I just paid my \$10 so that I can be graced with a replacement that will
21	I was glad to find this drive because I needed the expansion for my Mac mini. So far it's done it's job. My El Gato tuner now has ample storage to for over-the-air broadcast DVRing. However, (CURSES!) the adapter is noisy! It gives the constant hiss of a faucet that's not been turned off all the way. It only goes away when the drive is working and not in sleep mode. Don't the Seagate people know that nowadays a silent system is a good system? I don't have another drive to backup my recordings and return it, so I am going to have to do research and buy an aftermarket adapter. I thought this was such a great buy.
22	The first unit I got would transfer about 3GB of data and hung. I have purchased numerous drives from Seagate, all of them are good until this time. Seagate used to be on top of my list..... I now have reservation.
23	It started making noise and died after a week. The second time I have a problem with seagate external drives. There is no 3rd time for me
24	This external hard drive crashed less than 2 months after I bought it! Don't buy it! This is my last Seagate ever!
25	After having the disk plugged in for 3 weeks straight I took it to my girlfriend's parents house. I plugged it in, no power. Made sure all connectors (USB, both sides of AC adapter) were secure, still no sound nor light. Tried another outlet. Nothing. Got home, still dead. The drive was in my leather laptop bag and handled with great care as my laptop is a \$1000+ laptop. I know it's just the luck of the draw with hard drives sometimes but I think next time I'll try another brand because just last week I had to RMA a 1.5tb sata seagate drive that had flash problems in the beginning after only 2 years bit the dust with
26	The drive died a week ago. Before that, it was great. It was fast and did exactly what I needed.
27	I thought seagate was a good brand. It went dead after about a month. Western Digital I had before lasted about a year. Trying a Toshiba now...
28	The drive was heavy, but acceptable. The power brick was quite heavy and too bulky for my purposes. I sold it t my cost to a delighted friend.
29	I'd been buying these in 2TB, but grabbed this one as a hopeful increase. I don't know what's different about it, but I can't use it in my Mac's zpool and my FreeBSD machine turns off when I plug it in. I can use it as an HFS volume, but 3TB of HFS is kind of scary for me.
30	I've had the drive for a week or so -- first thing I noticed was the noise. You can hear the drive spinning at least 4 ft away before the sound starts to fade. I bought two drives and both have this problem.
31	I use this drive to do backups via Lap Link on my traveling notebook. To address the heat generated and lack of air vents, noted by others, I sit the unit on two paperweights with a gap below to aid in ventilation. Otherwise, it sits in the vault.
32	The first time I tried to unplug my drive, the sheath of the usb plug came off and got stuck in the usb slot of the drive, rendering the thing unusable, since I couldn't remove the sheath from the slot or re-plug the cord into the drive. Seems to me, that indicates pretty poor workmanship/materials. Not what you want in a drive if you're looking for a reliable backup for important files. Also, no response from customer
33	Good performance, but not portable....The price for handling was higher than a laptop...It is compatible with USB 3.0 and runs ok with windows 8
34	perfect that it is reasonable price, but t also has heating problem (when you use it for several hours, become hot)
35	I have tried various so called solutions I have seen to solve the problem of playing DVDs copied in this hard drive in WMC, but all of them stop after few seconds after pressing play (in about 3 seconds). I changed PCs, formats of this hard drive, used seagate tool, etc., etc. None worked. I've seen the same problem reported in Seagate's community Q/A site but did not see anyone answering that question. I wonder why.
36	I bought this large-capacity drive for use with my photo processing work. I love the USB speed when I move a large number of really big files in and out. However, I have to reboot my computer every morning in or der to use the drive. It disappears from my drive list almost every night when the computer goes into hibernation mode and will not come back without reboot. I have seven hard disks on this tower
37	Nice solid case, but when the drive is active it's louder than other externals I have had. Not just when writing, even when just spinning. The plus side is it does get quiet if I unmount the drive.
38	Very disappointed because Seagate used to be my first choice. Can't use it for Time Machine backups whether connected via USB to a MacBook Pro running Mountain Lion or Time Capsule. Disconnects during backups roughly after 15 minutes. This results in not creating the sparse bundle when connected to Time Capsule or pausing backup with an error message when plugged into the Mac. I set the System Preference Energy settings to not sleep the computer or drives to no avail. Tried reformatting each time. The Seagate site talks about using Disk Utility to prepare drive for use with Time Capsule, but

	J	K	L	M	N	O	P	Q	R	S	T	U
15	Issue	eject										
16	Issue	setup										
17	Issue	compatible										
18	Issue	rma										
19	Issue	capacity										
20	Issue	rma										
21	Issue	noisy										
22	Issue	freezes										
23	Issue	rma										
24	Issue	rma										
25	Issue	power										
26	Issue	rma										
27	Issue	rma										
28	Feedback	heavy										
29	Issue	power										
30	Issue	noisy										
31	Feedback	heat										
32	Issue	connection	support									
33	Feedback	heavy										
34	Feedback	heat										
35	Issue	media										
36	Issue	drops offline										
37	Issue	noisy										
38	Issue	Mac										

	A	B	C	D	E	F
39	1	1/8/2013	MJD	Danger - causes Windows 8 Pro 64 bit to freeze	y	n
40	1	1/8/2013	songster128	Not reliable	y	n
41	1	1/10/2013	Shaunapger	won't get it again	y	n
42	2	1/12/2013	S. S. Ulrey "stu"	not compatible with Windows 7 backup	y	n

	G	H
39	http://www.amazon.com/review/R1XBKN0HJ98JWS/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
40	http://www.amazon.com/review/R31QAD47ANSWYJ/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
41	http://www.amazon.com/review/RTZZF63IGF8UT/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop
42	http://www.amazon.com/review/R1VZKAZI7B7FV1/ref=cm_cr_pr_perm?ie=UTF8&ASIN=B00834SJU8&linkCode=&nodeID=&tag=	Expansion Desktop

	I
	I worked with Microsoft support for 6 days to isolate the issue to this drive. It took over 25 hours of my personal time.
39	When I received the drive I placed all files that came with the drive in a folder labeled "Seagate" and then used it with Microsoft File History. The computer worked for a days before freezing and then got more
	I purchased this 3 TB Seagate drive in October. Used it as a data backup for photographs, keeping the drive on my desk (not moving it) so in good conditions for such equipment. (I carry smaller drives in my backpack while traveling with my camera and laptop. After ten weeks the drive stopped working.
	Under warranty, Seagate will replace the drive, but they want me to pay them to try to recover the data. Personally I don't think this is acceptable.
40	I find the lack of reliability and Seagate's unwillingness to warrant the function of the drive -- data storage -- unacceptable.
	I got this to back up all my files. I was able to back up 25GB worth then the next morning I couldnt even access it the computer wouldnt recognize it so I tried trouble shooting it from the website did nothing. I
41	got a replacement one from amazon within a week. Awsome Job Amazon. set everything up and got about 50 GB this time befor it started beeping clicking and could not access this one either. So I wont be
	The 3Tb drive says it is compatible with Windows 7 and 3rd-party backup tools, but despite my best efforts, I can't find any way to use my preferred backup tool (Windows Backup) with this it. I've tried
42	reformatting it several different ways. Is there any way to get this to work? Not that I can find. I want to use this drive for a full system backup. I'm able to use Seagate's DiscWizard for this, but since it doesn't

	J	K	L	M	N	O	P	Q	R	S	T	U
39	Issue	compatible										
40	Issue	data loss	freezes									
41	Issue	rma	noisy	self-help								
42	Issue	compatible										

	A	B	C	D	E	F	G	H	I
1	COMPLAINTS								
2	Tag		Complaint	Drill Down					
3	rma		Drive Failed	backup for our photography business and it failed 2 months after we purchased it; failed me after 2 uses;started making noise					
4	setup		Instructions	did not come with any instructions about how to deal with this problem with XP chipset driver;The directions were alot harder					
5	cable		Cable	cable sometimes wiggles around and causes the HD to disconnect from the computer;					
6	data loss		Data Recovery	Data recovery is not covered and they offered to recover it for \$500 to \$1000:I feel like my files are being held hostage for this					
7	compatible		Compatibility	have not gotten it to work on my Windows 7 Home Premium;Danger - causes Windows 8 Pro 64 bit to freeze;can't find any way					
8	on/off, eject		Power	have to unplug and plug back in to get the drive recognized:try to right click and eject the drive the eject option isn't present;no					
9	format		Setup	was able to get the drive to work perfectly not after 30 seconds as mentioned on the website but after 3 hours of troubleshooting					
10	noisy		Noise	faint beeping sound;noisy adapter;can hear the drive spinning at least 4 ft away before the sound starts to fade,it's louder than					
11	capacity		Drive Capacity	shows the hard drive as only having 3 GB. YES I said 3 GB rather than 3 TB;					
12	freezes		Locks Up	would transfer about 3GB of data and hung					
13	support		Bad Support	no immediate response from support					
14	connection		Connector	sheath of the usb plug came off and got stuck in the usb slot of the drive, rendering the thing unusable;					
15	movie files		Media	after files copied to HD won't play with Windows Media Center;					
16	drops offline		Offline	disappears from my drive list almost every night when the computer goes into hibernation mode and will not come back without					
17	Mac		Mac Usability	whether connected via USB to a MacBook Pro running Mountain Lion or Time Capsule it disconnects during backups roughly					
18	self-help		Website	tried trouble shooting it from the website but it did nothing for me;					
19									
20									
21									
22									
23									
24									
25									
26	FEEDBACK								
27	tag		Feedback	Drill Down					
28	case		Case	would have liked to have seen the shell of this aluminum or some grade so it doesn't feel so fragile; really flimsy chassis;					
29	connection		Connection	it's a USB connection to the computer but the wire to the hard drive is NOT USB;					
30	heavy		Weight	Drive is too heavy but acceptable;price for shipping and handling was higher than a laptop;					
31	heat		Drive Heat	To address the heat generated and lack of air vents, noted by others, I sit the unit on two paperweights with a gap below to aid in					
32									
33									

[illegible]

	K
1	
2	
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5	
6	http://www.amazon.com/Seagate-Expansion-Desktop-External-STBV3000100/product-reviews/B00834SJU8/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
7	http://www.amazon.com/Seagate-Expansion-Portable-External-STBX1000100/product-reviews/B00834SK5W/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
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13	http://www.amazon.co.uk/Seagate-Expansion-inch-Desktop-Drive/dp/B0084LZJ2G/ref=sr_1_2?s=computers&ie=UTF8&qid=1347630002&sr=1-2
14	http://www.amazon.co.uk/product-reviews/B0084LZJ1M/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
15	http://www.amazon.co.uk/product-reviews/B0084LZIB8/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
16	http://www.amazon.co.uk/product-reviews/B0084LZIZO/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
17	http://www.amazon.co.uk/product-reviews/B005LF89H0/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
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19	http://www.amazon.de/Seagate-STBV1000200-Expansion-Desktop-Festplatte/product-reviews/B0084LZJ2G/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
20	http://www.amazon.de/Seagate-STBX1000200-Expansion-Portable-Festplatte/product-reviews/B0084LZIZO/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
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24	http://www.amazon.fr/Seagate-Expansion-Desktop-Disque-externe/product-reviews/B0084LZ15Y/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
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31	http://www.newegg.com/Product/Product.aspx?Item=N82E16822178116&SortField=0&SummaryType=0&PageSize=10&SelectedRating=-1&VideoOnlyMark=False&IsFeedbackTab=true#scrollFullInfo
32	http://www.newegg.com/Product/Product.aspx?Item=N82E16822178117&SortField=0&SummaryType=0&PageSize=10&SelectedRating=-1&VideoOnlyMark=False&IsFeedbackTab=true#scrollFullInfo
33	http://www.newegg.com/Product/Product.aspx?Item=N82E16822178113&SortField=0&SummaryType=0&PageSize=10&SelectedRating=-1&VideoOnlyMark=False&IsFeedbackTab=true#scrollFullInfo
34	http://www.newegg.com/Product/Product.aspx?Item=N82E16822178114&SortField=0&SummaryType=0&PageSize=10&SelectedRating=-1&VideoOnlyMark=False&IsFeedbackTab=true#scrollFullInfo
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43		Expansion Portable	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	+
44		Expansion Desktop	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	+
45										
46		Falcon	197	95	154	605	1630	#NAME?	#NAME?	+
47										
48										
49		Desktop Falcon	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
50		Amazon US	86	33	44	196	520	#NAME?	#NAME?	
51		Amazon UK	42	22	34	180	542	#NAME?	#NAME?	
52		Amazon FR	6	5	17	40	76	144	4.2	
53		Amazon DE	14	10	15	49	141	229	4.3	
54		Best Buy	0	0	0	0	0	0	0.0	
55		New Egg	22	12	26	48	90	198	3.9	
56		Combined	170	82	136	513	1369	#NAME?	#NAME?	=
57										
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59		Portable Falcon	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
60		Amazon US	7	4	8	11	43	#NAME?	#NAME?	
61		Amazon UK	5	5	4	27	91	#NAME?	#NAME?	
62		Amazon FR	0	0	0	0	0	0	0.0	
63		Amazon DE	0	0	1	7	14	22	4.6	
64		Best Buy	0	0	0	0	0	0	0.0	
65		New Egg	15	4	5	47	113	153	5.2	
66		Combined	27	13	18	92	261	#NAME?	#NAME?	=
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2			1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
3		COMBINED	821	212	246	865	2349	#NAME?	#NAME?	
4										
5		AMAZON.COM	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
6	r	STAY1000102								
	r	STAY2000102								
	r	STAY3000100								
	rd	STAY3000102	128	31	31	53	144	#NAME?	#NAME?	
7	r	ST305004EXA101-RK								
	r	ST315005EXA101-RK								
	rd	ST320005EXA101-RK	149	33	31	87	169	#NAME?	#NAME?	
8	r	STAX500102								
	r	STAX750102								
	r	STAX1000102								
	r	STAX1500100								
	rp	STAX1500102	35	4	6	33	94	#NAME?	#NAME?	
9	r	ST903204EXA101-RK								
	r	ST905004EXA101-RK								
	r	ST906404EXA101-RK								
	r	ST907504EXA101-RK								
	rp	ST910004EXA101-RK	122	36	53	149	470	#NAME?	#NAME?	
10										
11		Combined	434	104	121	322	877	#NAME?	#NAME?	
12										
13										
14		AMAZON.CO.UK	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
15	r	STAY1000202								
	r	STAY2000202								
16	r	STAY3000200	3	3	0	3	15	#NAME?	#NAME?	
17	rd	STAY3000202	0	0	2	0	3	#NAME?	#NAME?	
	rd	STAY3000202	0	2	0	7	4	#NAME?	#NAME?	
18	r	ST310005EXD101-RK								
	rd	ST320005EXD101-RK	170	42	50	248	576	#NAME?	#NAME?	
19	r	ST903204EXD101-RK	4	1	1	9	27	#NAME?	#NAME?	
20	r	ST905004EXD101-RK	64	17	14	76	296	#NAME?	#NAME?	
21	r	ST907504EXD101-RK	0	0	0	1	2	#NAME?	#NAME?	
22	rp	ST910004EXD101-RK	8	2	2	8	23	#NAME?	#NAME?	
23		Combined	249	67	69	352	946	#NAME?	#NAME?	
24										
25		AMAZON.DE	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
26	r	STAY1000202								
	r	STAY2000202								
	r	STAY3000202	2	1	0	0	0	3	1.33	
27	rd	STAY3000200	0	0	0	1	2	3	4.67	
28	r	ST310005EXD101-RK	14	4	3	7	20	48	3.31	
29	r	ST315005EXD101-RK	3	0	0	0	1	4	2.00	
30	rd	ST320005EXD101-RK	16	2	2	2	7	29	2.38	
31	r	ST903204EXD101-RK	2	0	0	3	13	18	4.39	
	r	ST905004EXD101-RK								
	r	ST906404EXD101-RK								
	r	ST910004EXD101-RK	22	11	10	37	193	273	4.35	

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6	http://www.amazon.com/Seagate-Expansion-Desktop-External-STAY3000102/product-reviews/B0056YNA1Q/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
7	http://www.amazon.com/Seagate-Expansion-Desktop-External-ST315005EXA101-RK/product-reviews/B0025KXMKs/ref=cm_cr_dp_see_all_btm?ie=UTF8&showViewpoints=1&sortBy=bySubmissionDateDes
8	http://www.amazon.com/Seagate-Expansion-Portable-External-STAX1500102/product-reviews/B0056YNACU/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
9	http://www.amazon.com/Seagate-Expansion-Portable-External-ST905004EXA101-RK/product-reviews/B001UHWHO4/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
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15	http://www.amazon.co.uk/product-reviews/B005LF899S/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
16	http://www.amazon.co.uk/product-reviews/B004HB6LQ0/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
17	http://www.amazon.co.uk/product-reviews/B005LF8966/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
18	http://www.amazon.co.uk/product-reviews/B00238KZPM/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
19	http://www.amazon.co.uk/product-reviews/B001XLX23C/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
20	http://www.amazon.co.uk/product-reviews/B001XM4P1O/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
21	http://www.amazon.co.uk/product-reviews/B002VDAA4Y/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
22	http://www.amazon.co.uk/Seagate-Expansion-Portable-Hard-Drive/dp/B0035O3DCK/ref=sr_1_1?s=computers&ie=UTF8&qid=1347631099&sr=1-1
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26	http://www.amazon.de/Seagate-STAY1000202-External-Desktop-Festplatte/product-reviews/B005LF899S/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
27	http://www.amazon.de/SEAGATE-External-Desktop-7200rpm-USB2-0/product-reviews/B004HB6LQ0/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
28	http://www.amazon.de/product-reviews/B00238KZPM/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
29	http://www.amazon.de/product-reviews/B0021ACXPC/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
30	http://www.amazon.de/product-reviews/B00213BINU/ref=dp_top_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
31	http://www.amazon.de/Seagate-External-Portable-Drive-ST903204EXD101-RK/product-reviews/B001XLX23C/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
32	http://www.amazon.de/product-reviews/B001XM4P1O/ref=cm_cr_pr_btm_link_1?ie=UTF8&showViewpoints=0

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33	rp	ST907504EXD101-RK	1	0	2	0	1	4	3.00	
34		Combined	60	18	17	50	237	382	4.01	
35										
36		AMAZON.FR	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
37	r	STAY1000202								
	r	STAY2000202								
	r	STAY3000200	4	2	3	7	6	22	3.41	
	r	STAY3000202								
38	rd	ST310005EXD101-RK	6	1	4	19	25	55	4.02	
		ST320005EXD101-RK								
39	r	STAX500202								
	r	STAX1000202	0	0	1	2	9	12	4.67	
	r	STAX1500200								
	r	STAX1500202								
40	r	ST905004EXD101-RK	18	8	11	78	162	277	4.29	
41	r	ST907504EXD101-RK	0	0	0	2	3	5	4.60	
42	rp	ST910004EXD101-RK	3	1	1	5	12	22	4.00	
43		Combined	31	12	20	113	217	385	4.20	
44										
45		BESTBUY.COM	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
46	rd	ST320005EXA101-RK	4	1	0	2	2	9	2.67	
47	r	ST905004EXA101-RK	4	0	1	2	12	19	3.96	
48	r	ST907504EXA	1	0	0	2	1	4	3.50	
49	rp	ST910004EXA101-RK	3	1	1	2	3	10	3.10	
50		Combined	12	2	2	8	18	42	3.43	
51										
52		NEWEGG.com	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
53	rd	STAY2000102	12	6	4	11	21	54	3.43	
54	rd	STAY3000102	15	2	8	6	21	52	3.31	
55	rp	STAX500102	3	0	4	2	6	15	3.53	
56	rp	STAX1000102	5	1	1	1	6	14	3.14	
57		Combined	36	9	17	20	54	136	3.36	
58										
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60										
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62			1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
63		COMBINED	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	=
64										
65		Expansion Portable	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#NAME?	#VALUE!	=
66		Expansion Desktop	526	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#NAME?	#VALUE!	=
67										
68		Raptor	821	212	246	865	2349	#NAME?	#NAME?	=
69										
70		Desktop Raptor	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
71		Amazon US	277	64	62	140	313	#NAME?	#NAME?	
72		Amazon UK	173	47	52	258	598	#NAME?	#NAME?	
73		Amazon FR	10	3	7	26	31	77	3.8	

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33	http://www.amazon.de/Seagate-Expansion-Portable-Drive-Festplatte/product-reviews/B002WDAA4Y/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
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37	http://www.amazon.fr/Seagate-STAY1000202-Expansion-Desktop-externe/product-reviews/B005LF899S/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
38	http://www.amazon.fr/Seagate-Expansion-ST310005EXD101-RK-Disque-externe/product-reviews/B00238KZPM/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
39	http://www.amazon.fr/Seagate-STAX500202-Expansion-Portable-externe/product-reviews/B005LF89H0/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
40	http://www.amazon.fr/Seagate-ST905004EXD101-RK-Disque-externe-portable/product-reviews/B001XM4P1O/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
41	http://www.amazon.fr/Seagate-Expansion-Portable-Drive-Hi-Speed/product-reviews/B002WDAA4Y/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
42	http://www.amazon.fr/Seagate-External-Portable-Drive-Hi-Speed/product-reviews/B0035O3DCK/ref=sr_1_1_cm_cr_acr_txt?ie=UTF8&showViewpoints=1
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46	http://www.bestbuy.com/site/Seagate+-+Expansion+2TB+External+USB+2.0+Hard+Drive/9481009.p?skuld=9481009&id=1218112361849#tabbed-customerreviews
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48	http://www.bestbuy.com/site/Seagate+-+Expansion+500GB+External+USB+2.0+Portable+Hard+Drive+-+Black/9238185.p?skuld=9238185&id=1218065492389#tabbed-customerreviews
49	http://www.bestbuy.com/site/Seagate+-+Expansion+1TB+External+USB+2.0+Portable+Hard+Drive+-+Black/1144846.p?skuld=1144846&id=1218224798119#tabbed-customerreviews
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53	http://www.newegg.com/Product/Product.aspx?Item=N82E16822148848&SortField=0&SummaryType=0&PageSize=10&SelectedRating=-1&VideoOnlyMark=False&IsFeedbackTab=true#scrollFullInfo
54	http://www.newegg.com/Product/Product.aspx?Item=N82E16822148865&SortField=0&SummaryType=0&PageSize=10&SelectedRating=-1&VideoOnlyMark=False&IsFeedbackTab=true#scrollFullInfo
55	http://www.newegg.com/Product/Product.aspx?Item=N82E16822148863&SortField=0&SummaryType=0&PageSize=10&SelectedRating=-1&VideoOnlyMark=False&IsFeedbackTab=true#scrollFullInfo
56	http://www.newegg.com/Product/Product.aspx?Item=N82E16822148860&SortField=0&SummaryType=0&PageSize=10&SelectedRating=-1&VideoOnlyMark=False&IsFeedbackTab=true#scrollFullInfo
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74		Amazon DE	35	7	5	10	30	87	2.9	
75		Best Buy	4	1	0	2	2	9	2.7	
76		New Egg	27	8	12	17	42	106	3.4	
77		Combined	526	130	138	453	1018	#NAME?	#NAME?	=
78										
79										
80		Portable Raptor	1-Star	2-Star	3-Star	4-Star	5-Star	Total	Wt Avg	
81		Amazon US	157	40	59	182	564	#NAME?	#NAME?	
82		Amazon UK	76	20	17	94	348	#NAME?	#NAME?	
83		Amazon FR	21	9	13	87	186	316	4.3	
84		Amazon DE	25	11	12	40	207	295	4.3	
85		Best Buy	8	1	2	6	16	33	3.6	
86		New Egg	8	1	5	3	12	29	3.3	
87		Combined	295	82	108	412	1333	#NAME?	#NAME?	=
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TimeLastMod	11:41 AM	ORIGINAL

EXHIBIT 19

From: Mark W Hall <mark.w.hall@seagate.com>
Sent: Friday, February 28, 2014 2:48 PM
To: Mary Shartle <mary.m.shartle@seagate.com>
Cc: Barbara J Craig <barbara.j.craig@seagate.com>; Aubrey Muhlach <aubrey.muhlach@seagate.com>; Teresa Nykilchuk <teresa.nykilchuk@seagate.com>; Joshua Walti <joshua.walti@seagate.com>; Joanne Chan <joanne.chan@seagate.com>; Joni J Clark <joni.j.clark@seagate.com>; Jennifer L Bradfield <jennifer.l.bradfield@seagate.com>
Subject: Re: REMINDER INPUT NEEDED: It's Time to Update the Storage Solutions Guide!
Attach: SSG1351.14-1310US_October2013 (M Hall Edits 2-28-14).pdf

Mary, updates attached. Primarily 600 and 600 Pro SSD have been EOL'd so need to be edited out. If you need more fodder to fill the page for for the 1200 I can come up with some.

Best regards,
Mark W. Hall
Sr. Marketing Manager, Flash Portfolio
Global Marketing

Seagate Technology – MS: SHK202 – 1280 Disc Drive – Shakopee, MN 55379

Cell: 612-244-5466
Office: 952-402-2987

On Thu, Feb 27, 2014 at 3:57 PM, Mary Shartle <mary.m.shartle@seagate.com> wrote:

Hello Product Marketing,

Just a reminder that your edits to the Storage Solution Guide are due by end of business **tomorrow, Friday2/28.**

Thanks,
Mary

What I need from you:

- Download the attached pdf and review the entire document (Table of Contents, At-a-Glance Product Comparisons, individual product intros and product features).

- Use the editing tools to markup the document with your requested changes. This document will launch on 4/1. Keep that date in mind while making your changes.
- Return the document to me. I'll consolidate all of your requested edits and work with Tom McCall's team on production.
- Your changes are due to me prior to **Friday, February 28th.**

On Wed, Feb 19, 2014 at 1:21 PM, Mary Shartle <mary.m.shartle@seagate.com> wrote:

Hello Product Marketing Managers,

The Storage Solutions Guide is a valuable tool that is frequently downloaded and referenced. It has not been updated since October and many of us are fielding requests for an updated guide.

I need your help in order to ensure that we're communicating accurate information to our customers.

What I need from you:

- Download the attached pdf and review the entire document (Table of Contents, At-a-Glance Product Comparisons, individual product intros and product features).
- Use the editing tools to markup the document with your requested changes. This document will launch on 4/1. Keep that date in mind while making your changes.
- Return the document to me. I'll consolidate all of your requested edits and work with Tom McCall's team on production.
- Your changes are due to me prior to **Friday, February 28th.**

Thanks in advance for your help. Please let me know if you have questions.

Best,
Mary

FED_SEAG0004783**Metadata**

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TO	Mary Shartle <mary.m.shartle@seagate.com>	ORIGINAL

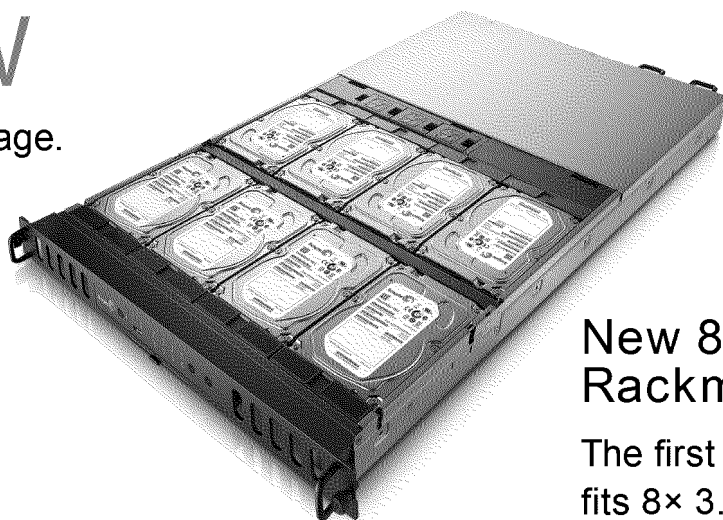


Storage Solutions Guide

OCTOBER 2013 | AMER

ROOM TO GROW

Double the storage.
Half the space.



New 8-Bay Rackmount NAS

The first 1U rack that
fits 8× 3.5" drives



Seagate

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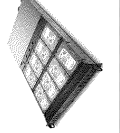




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FED SEAG0004787

External Storage

At-a-Glance Product Comparison

Case 3:16-cv-00523-JCS Document 207 Filed 02/06/19 Page 230 of 608

BACKUP PLUS				SLIM		EXPANSION	
Direct Attached/ Portable		Backup Plus Portable	Protecting and sharing digital memories		Backup Plus Desktop		Backup Plus for Mac
		Backup Plus for Mac	Keeping your digital life safe and sound		Backup Plus Desktop for Mac		Backup Plus for Mac Desktop Thunderbolt
PERFECT FOR	Protecting and sharing digital memories		Keeping your digital life safe and sound	Thin storage that fits—and goes—anywhere	Slim Portable	Slim Portable for Mac	Expansion Portable
DESCRIPTION	Store and back up the content on your social networks with these flexible, portable drives, PC or Mac.		These desktop drives provide the simple, one-click way to protect and share files, PC or Mac.	This ultra-thin metal design is the world's sleekest portable external hard drive, PC or Mac.			Expansion drives allow you to instantly add more storage space to your computer and take large files with you.
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Wireless Mobile		Wireless Plus			Business Storage 8-Bay Rackmount NAS		Business Storage 4-Bay Rackmount NAS
		Business Storage 4-Bay Rackmount NAS	Centralized storage and backup		Business Storage 2-Bay NAS		Central
PERFECT FOR	Wireless storage for your tablet		Centralized storage and backup	Centralized storage, collaboration and backup	Business Storage 2-Bay NAS	Wireless centralized home storage	
DESCRIPTION	Take your media library on the go and stream it wirelessly to your iPad, Android tablet and smartphone, PC or Mac.		A complete, high-performance network storage for businesses with up to 100 employees	The first 1U rack that fits eight hot-swappable 3.5-inch drives	A complete network storage solution and private cloud for businesses of up to 25 employees.	A complete network storage solution and private cloud for home offices.	This shared storage device automatically backs up multiple Macs and PCs plus streams your shared library to the connected devices in the home.
LEARN MORE	Page 10		Page 11	Page 12	Page 12	Page 13	Page 11

Backup Plus

The Backup Plus portable drive is the simple way to protect and share your entire digital life.

Key Advantages

- Easy, flexible backups
- Automatically saves photos from social networks
- Photos and videos can be shared to social networks with a click.
- Thunderbolt technology or FireWire 800 upgrade allows higher transfer speeds

Best-Fit Applications

- Store or back up photos, movies, music and documents.
- Download and save content that's posted on your social networks.
- Share your digital memories to your social networks with a click.

External Storage Solutions

Seagate external storage solutions are sleek, dependable and ultra-portable products that let your customers automatically and continuously store digital family photos, protect critical business data, back up multiple computers on a small network, or share and store videos and music.

CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
1TB	STBU1000100	USB 3.0	● Black	PC, Mac
1TB	STBU1000101	USB 3.0	● Silver	PC, Mac
1TB	STBU1000102	USB 3.0	● Blue	PC, Mac
1TB	STBU1000103	USB 3.0	● Red	PC, Mac
750GB	STBU750100	USB 3.0	● Black	PC, Mac
PRODUCT DIMENSIONS	4.86-in L x 3.19-in W x 0.57-in D (123.4mm x 81.1mm x 14.5mm)			
PACKAGE DIMENSIONS	5.2-in L x 1.81-in W x 6.54-in D (132mm x 46mm x 166mm)			



1 One terabyte (TB) equals one billion bytes and one terabyte (TB) equals one trillion bytes when referring to drive capacity.
2 U.S. model numbers shown.

Backup Plus for Mac

The Backup Plus portable drive for Mac is the simple way to protect and share your entire digital life.

Key Advantages

- Mac OS and Time-Machine ready out of the box
- Automatically saves photos from social networks
- Share photos and video to social networks with a click.
- Easily increase transfer speeds by upgrading to Thunderbolt technology.

Best-Fit Applications

- Store or back up photos, movies, music and documents.
- Download and save content that's posted on your social networks.
- Share your digital memories to your social networks with a click.



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
1TB	STBW1000900	USB 3.0	● Silver/ ○ White	Mac, PC
PRODUCT DIMENSIONS	4.86-in L x 3.19-in W x 0.57-in D (123.4mm x 81.1mm x 14.5mm)			
PACKAGE DIMENSIONS	5.2-in L x 1.81-in W x 0.54-in D (132mm x 46mm x 16mm)			

Backup Plus for Mac Portable Thunderbolt™

The Thunderbolt Backup Plus for Mac portable drive is everything you need to transfer, store and back up files using Thunderbolt technology.

Key Advantages

- Includes Thunderbolt cable, adapter and drive
- Compatible with Time Machine software
- Compatible with Thunderbolt devices
- No external power supply required

Best-Fit Applications

- Combine high-speed data transfer and high-definition display in a single interface
- Unleash your creativity using high-bandwidth media-capturing devices while processing in real time
- Handle vast amounts of data more precisely than with any other connection
- Back up and restore data at 10Gbps



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
1TB	STBW1000401	Thunderbolt	● Black	Mac, PC
PRODUCT DIMENSIONS	5.12-in L x 3.19-in W x 1.09-in D (130mm x 81mm x 27.8mm)			
PACKAGE DIMENSIONS	6.69-in L x 5.24-in W x 1.81-in D (169mm x 133mm x 46mm)			

Backup Plus Desktop for Mac

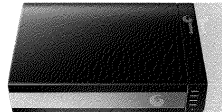
The Backup Plus desktop drive for Mac is the simple, one-click way to protect and share your entire digital life.

Key Advantages

- Mac OS and Time Machine ready right out of the box
- Automatically saves photos from social networks
- Share photos and video to social networks with a click.
- Up to 3TB capacity for a lifetime of memories

Best-Fit Applications

- Back up all your important files.
- Download and save content that's posted on your social networks.
- Share your digital memories to your social networks with a click.



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
4TB	STCB4000901	USB 3.0	● Black/ ● Silver	Mac, PC
3TB	STCB3000900	USB 3.0	● Black/ ● Silver	Mac, PC
2TB	STCB2000900	USB 3.0	● Black/ ● Silver	Mac, PC
PRODUCT DIMENSIONS	6.22-in L x 4.88-in W x 1.73-in D (158mm x 124mm x 44mm)			
PACKAGE DIMENSIONS	7.87-in L x 9.08-in W x 3.54-in D (200mm x 230mm x 90mm)			

Backup Plus for Mac Desktop Thunderbolt

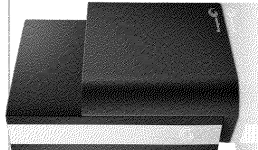
The Thunderbolt Backup Plus for Mac desktop drive is everything you need to transfer, store and back up files using Thunderbolt technology.

Key Advantages

- Includes Thunderbolt cable, adapter and drive
- Dual ports enable daisy-chaining up to six devices
- Compatible with Thunderbolt displays and other devices
- Compatible with Time Machine software

Best-Fit Applications

- Combine high-speed data transfer and high-definition display in a single interface
- Unleash your creativity using high-bandwidth media-capturing devices while processing in real time
- Handle vast amounts of data more precisely than with any other connection
- Back up and restore data at 10Gbps



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
3TB	STCB3000400	Thunderbolt	● Black	Mac, PC
PRODUCT DIMENSIONS	6.61-in L x 4.76-in W x 2.42-in D (168mm x 120.9mm x 61.4mm)			
PACKAGE DIMENSIONS	8.64-in L x 9.13-in W x 3.5-in D (219.5mm x 232mm x 89mm)			

Backup Plus Desktop

The Backup Plus desktop drive is the simple, one-click way to protect and share your entire digital life.

Key Advantages

- Easy, flexible, built-in backup options
- Automatically saves photos from social networks
- Photos and videos can be shared to social networks with a click.
- Up to 4TB capacity for a lifetime of memories
- Increase transfer speeds by upgrading to Thunderbolt technology or FireWire 800.

Best-Fit Applications

- Back up all your important files.
- Download and save content that's posted on your social networks.
- Share your digital memories to your social networks with a click.



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
4TB	STC44000100	USB 3.0	● Black	PC, Mac
3TB	STC33000101	USB 3.0	● Black	PC, Mac
2TB	STC23000100	USB 3.0	● Black	PC, Mac
1TB	STC13000100	USB 3.0	● Black	PC, Mac
PRODUCT DIMENSIONS	6.22-in L x 4.88-in W x 1.73-in D (158mm x 124mm x 44mm)			
PACKAGE DIMENSIONS	7.87-in L x 9.06-in W x 3.54-in D (200mm x 230mm x 90mm)			

Slim for Mac

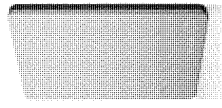
The Seagate Slim portable drive for Mac combines a thin, light form factor in a Time Machine-ready drive.

Key Advantages

- Just slightly thicker than an iPhone
- Mac OS and Time Machine ready out of the box
- Automatically saves photos from social networks
- Photos and videos can be shared to social networks with a click.

Best-Fit Applications

- Store or back up photos, movies, music and documents.
- Download and save content that's posted on your social networks.
- Share your digital memories to your social networks with a click.



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
500GB	STC500102	USB 3.0	● Silver	Mac, PC
PRODUCT DIMENSIONS	4.47-in L x 2.99-in W x 0.38-in D (113.5mm x 76mm x 9.6mm)			
PACKAGE DIMENSIONS	5.59-in L x 1.22-in W x 4.06-in D (142mm x 31mm x 103mm)			

Slim

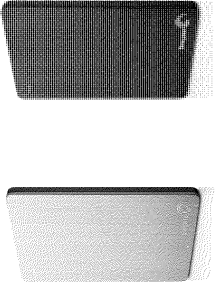
The Seagate Slim portable drive is thin, light and the easiest way yet to back up the things that are important to you.

Key Advantages

- Just slightly thicker than an iPhone
- Protects your stuff with easy, flexible backups
- Automatically saves photos from social networks
- Photos and videos can be shared to social networks with a click.

Best-Fit Applications

- Store or back up photos, movies, music and documents.
- Download and save content that's posted on your social networks.
- Share your digital memories to your social networks with a click.



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
500GB	STD500102	USB 3.0	● Black	PC, Mac
500GB	STD500104	USB 3.0	● Silver	PC, Mac
PRODUCT DIMENSIONS	4.47-in L x 2.99-in W x 0.38-in D (113.5mm x 76mm x 9.6mm)			
PACKAGE DIMENSIONS	5.59-in L x 1.22-in W x 4.06-in D (142mm x 31mm x 103mm)			

Expansion

The Expansion desktop drive provides extra storage for your ever-growing collection of files.

Key Advantages

- Simple and straightforward setup
- No software to install and nothing to configure
- Saving files is easy—simply drag and drop.
- USB 3.0 interface allows fast transfer speeds.

Best-Fit Applications

- Instantly add more storage space to your computer.
- Improve performance on your computer's internal drive by freeing up space on your internal drive.



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
4TB	STB4000100	USB 3.0	● Black	PC
3TB	STB3000100	USB 3.0	● Black	PC
2TB	STB2000100	USB 3.0	● Black	PC
1TB	STB1000100	USB 3.0	● Black	PC
PRODUCT DIMENSIONS	7.07-in L x 4.66-in W x 1.48-in D (179.5mm x 118mm x 37.5mm)			
PACKAGE DIMENSIONS	9.09-in L x 7.97-in W x 2.83-in D (231mm x 202mm x 72mm)			

¹ One gigabyte (GB) equals one billion bytes and one terabyte (TB) equals one trillion bytes when referring to drive capacity.
2 U.S. inches (millimeters shown).

Expansion

The Expansion portable drive is compact and perfect for taking large files with you on-the-go.

Key Advantages

- Simple and straightforward setup
- Powered from the USB cable
- Saving files is easy—simply drag and drop.
- USB 3.0 interface allows fast transfer speeds.

Best-Fit Applications

- Instantly add more storage space to your computer.
- Take large files with you when you travel.



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
1TB	STBX000101	USB 3.0	● Black	PC
750GB	STBX750100	USB 3.0	● Black	PC
500GB	STBX500100	USB 3.0	● Black	PC
PRODUCT DIMENSIONS (1TB)	5.04-in L x 3.51-in W x 0.87-in D (128.1mm x 89.1mm x 22mm)			
PRODUCT DIMENSIONS (500GB)	4.81-in L x 3.19-in W x 0.61-in D (122.3mm x 81.1mm x 15.5mm)			
PACKAGE DIMENSIONS	5.28-in L x 6.69-in W x 1.89-in D (134mm x 170mm x 48mm)			

Wireless Plus

With Wireless Plus mobile device storage, you can take your media library with you. Stream it to your iPad or Android tablet.

Key Advantages

- Take your media library with you on the go
- Share media with up to eight Wi-Fi enabled devices at the same time
- Use anywhere, without an Internet connection
- Up to 10 hours battery life³

Best-Fit Applications

- Store and carry movies and other media on the go.
- Share media with others.
- Works with iPad or Android tablets and smartphones



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
1TB	STCK1000100	USB 3.0	● Grey	PC, Mac
PRODUCT DIMENSIONS	5.00-in L x 3.50-in W x 0.78-in D (127mm x 89mm x 19.9mm)			
PACKAGE DIMENSIONS	2.00-in L x 6.02-in W x 7.16-in D (51mm x 153mm x 182mm)			

Central

The Central shared network storage system allows you to create secure in-home cloud storage for multiple computers in the home.

Key Advantages

- Automatically back up multiple PC and Mac computers
- Wirelessly stream your centralized media library to gaming consoles, media players and smart TVs
- Access content on-the-go with a Web browser or the free app for tablets and smartphones

Best-Fit Applications

- Consolidate content on one easily accessible device
- Back up multiple PC and Mac computers
- Enjoy a centralized media library on smart TVs, game consoles and media players
- Access your content on-the-go with laptops and mobile devices
- Archive your Facebook photos and videos



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
4TB	STCG4000100	SATA/GbE	● Black	PC, Mac
3TB	STCG3000100	SATA/GbE	● Black	PC, Mac
2TB	STCG2000100	SATA/GbE	● Black	PC, Mac
PRODUCT DIMENSIONS	5.7-in L x 8.5-in W x 1.7-in D (145mm x 216mm x 42mm)			
PACKAGE DIMENSIONS	3.15-in L x 10.3-in W x 9.25-in D (80mm x 261mm x 235mm)			

Business Storage 8-Bay Rackmount NAS

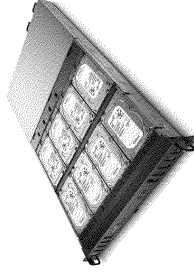
A complete network storage solution with innovative 8-bay design in a 1U form factor that is perfect for growing businesses

Key Advantages

- A 2.3GHz dual-core Intel processor delivers file transfer performance of up to 200MB/s
- Wuala™ cloud service and apps for secure collaboration and anywhere access
- Centralized backup for PCs, plus Time Machine support for Mac computers
- Support for iSCSI enables maximum performance and compatibility for virtualized environments

Best-Fit Applications

- Store business-critical files centrally and securely
- Back up your organization's PC and Mac computers
- Access and manage files remotely using Internet-connected computers and devices
- Back up files to the cloud



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
32TB	STDP32000100	Gigabit Ethernet	Black	PC, Mac
24TB	STDP24000100	Gigabit Ethernet	Black	PC, Mac
16TB	STDP16000100	Gigabit Ethernet	Black	PC, Mac
12TB	STDP12000100	Gigabit Ethernet	Black	PC, Mac
8TB	STDP80000100	Gigabit Ethernet	Black	PC, Mac
PRODUCT DIMENSIONS	30.394-in L x 17.13-in W x 18.78-in D (772mm x 43.5mm x 477mm)			
PACKAGE DIMENSIONS	35.354-in L x 23.465-in W x 8.661-in D (898mm x 596mm x 220mm)			

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity. Actual capacity may vary due to manufacturer's formatting.

² Actual performance may vary.

³ Stand battery life subject to product model, normal usage conditions and configurations.

Business Storage 4-Bay Rackmount NAS

Centralize your storage and backups with a complete network storage solution that saves valuable floor space for small businesses.

Key Advantages

- Centralized storage and backup for PCs and Macs, plus secure Wuala cloud off-site backup service
- A dual-core Intel Atom processor and new, performance-optimized Seagate NAS OS deliver file transfer speeds up to 200MB/s
- Anywhere access to your files
- Hot-swappable drives and dual Gigabit Ethernet ports help increase up-time

Best-Fit Applications

- Store business-critical files centrally and securely
- Back up your organization's PC and Mac computers
- Access and manage files remotely using Internet-connected computers and devices
- Back up files to the cloud



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
16TB	STDN16000100	Gigabit Ethernet	Black	PC, Mac
12TB	STDN12000100	Gigabit Ethernet	Black	PC, Mac
8TB	STDN8000100	Gigabit Ethernet	Black	PC, Mac
4TB	STDN4000100	Gigabit Ethernet	Black	PC, Mac
—	STDN100	Gigabit Ethernet	Black	PC, Mac
PRODUCT DIMENSIONS 16.929-in L x 15-in W x 1.713-in D (430mm x 381mm x 42.5mm)				
PACKAGE DIMENSIONS 22.44-in L x 19.367-in W x 6.495-in D (570mm x 493mm x 165mm)				

Business Storage 4-Bay NAS

A complete, small-business-specific network storage solution designed to provide optimum uptime and data integrity for up to 50 workstations

Key Advantages

- Easy 10-minute setup
- Upload and download files with free apps for iPhone, iPad and Android devices
- Full-system, automatic backup for PCs, plus Time Machine support for Mac computers
- Customize performance and data redundancy with RAID 0, 1, 5 and 10 configuration options

Best-Fit Applications

- Make automatic, continuous backups
- Store files in a secure, central location
- Access and manage files remotely using Internet-connected devices
- Create cost-effective, private cloud storage
- Encrypt individual files to entire volumes of data



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
16TB	STBP16000100	Gigabit Ethernet	Black	PC, Mac
12TB	STBP12000100	Gigabit Ethernet	Black	PC, Mac
8TB	STBP8000100	Gigabit Ethernet	Black	PC, Mac
4TB	STBP4000100	Gigabit Ethernet	Black	PC, Mac
—	STBP100	Gigabit Ethernet	Black	PC, Mac
PRODUCT DIMENSIONS 6.3-in W x 8.2-in H x 10.2-in D (161.0mm x 208.0mm x 258.50mm)				
PACKAGE DIMENSIONS 9.4-in W x 14.9-in H x 9.4-in D (240.0mm x 379.0mm x 243.0mm)				

Business Storage 2-Bay NAS

Create a private cloud to help protect your business-critical data and centralize files in a single location you can access from anywhere

Key Advantages

- Easy 10-minute setup
- Upload and download files with free apps for iPhone, iPad and Android devices
- Full-system, automatic backup for PCs, plus Time Machine support for Mac computers
- Customize performance and data redundancy with RAID 0 and 1 configuration options

Best-Fit Applications

- Make automatic, continuous backups of multiple PC and Mac computers
- Store files in a secure, central location
- Access and manage files remotely using Internet-connected computers, tablets and smartphones
- Create cost-effective, private cloud storage



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
8TB	STBN8000100	Gigabit Ethernet	Black	PC, Mac
6TB	STBN6000100	Gigabit Ethernet	Black	PC, Mac
4TB	STBN4000100	Gigabit Ethernet	Black	PC, Mac
—	STBN100	Gigabit Ethernet	Black	PC, Mac
PRODUCT DIMENSIONS 4.1-in W x 8.0-in H x 8.9-in D (104.50mm x 204.00mm x 227.00mm)				
PACKAGE DIMENSIONS 6.2-in W x 10.9-in H x 12.5-in D (157.00mm x 277.00mm x 317.00mm)				

Business Storage 1-Bay NAS

Create a private cloud with Seagate Business Storage 1-Bay NAS. It helps protect your all-important data and centralizes your files in a single location you can access from anywhere.

Key Advantages

- Easy 10-minute setup
- Upload and download files with free apps for iPhone, iPad and Android devices
- Full-system, automatic backup for PCs, plus Time Machine support for Mac computers
- Stream your media library to networked computers, Internet TVs, game consoles and more

Best-Fit Applications

- Make automatic, continuous backups of multiple PC and Mac computers
- Store files in a secure, central location
- Access and manage files remotely using Internet-connected computers, tablets and smartphones
- Create cost-effective, private cloud storage



CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
4TB	STBN4000100	Gigabit Ethernet	Black	PC, Mac
3TB	STBN3000100	Gigabit Ethernet	Black	PC, Mac
2TB	STBN2000100	Gigabit Ethernet	Black	PC, Mac
PRODUCT DIMENSIONS 2.4-in W x 6.8-in H x 5.8-in D (61mm x 175mm x 149mm)				
PACKAGE DIMENSIONS 3.7-in W x 8.3-in H x 9.0-in D (93mm x 236mm x 229mm)				

1 One gigabyte (GB) equals one billion bytes and one terabyte (TB) equals one trillion bytes when referring to hard drive capacity. 2 U.S. model numbers shown.

Internal Storage

At-a-Glance Product Comparison

ENTERPRISE			DESKTOP			SPECIALTY		
3.5-inch								
	High-capacity, compute-intensive environments requiring demanding high performance and availability	Bulk-data applications requiring reliable, highest-capacity storage efficiency and enterprise-class reliability	Cost-effective, low-power bulk storage solutions for unstructured data	Desktop solutions requiring SSD-like performance and massive capacities at an affordable price	Desktop compute where choice in capacity and cache options to provide design flexibility is important	Small NAS systems needing performance with high capacities. 3-year limited warranty	Surveillance systems that require high performance, low power and centralized storage or every surveillance application. 3-year limited warranty	DVR systems where reliable, low-power, purpose-built storage is required for video streaming applications. 3-year limited warranty
	USE THIS DRIVE FOR							
	ENCRYPTION MODELS AVAILABLE	X	X					
	LEARN MORE	Page 25	Page 26	Page 28	Page 32	Page 42	Page 42	Page 43

EOL'd Products												
SSD			ENTERPRISE SSD			ENTERPRISE			MOBILE			SPECIALTY
2.5-inch												
	Enterprise storage environments requiring high-capacity SSD with data integrity and drive endurance	Data center and cloud applications that require fast performance and low power	On-the-go users who need the fastest performance and improved ruggedness	Improved storage performance tier between SSDs and high-capacity HDDs	Compute-intensive data requirements demanding the highest HDD performance density and availability	Mainstream data requiring high capacity, performance density and reliability	Online reference data demands requiring cost-effective, low-power, enterprise-class drives	The ultimate mobile computing experience, with SSD-like performance for all applications and OS environments	Slim computing devices, such as laptops and netbooks	Slim laptops and devices that need light, affordable, high-capacity storage	Robust storage for high-capacity tablets and mobile applications	Video streaming where 24x7 operation, small form factor and low power consumption are needed. 3-year limited warranty
	USE THIS DRIVE FOR											
	ENCRYPTION MODELS AVAILABLE		X	X	X	X	X	X	X	X	X	
	LEARN MORE	Page 18	Page 18	Page 19	Page 22	Page 22	Page 24	Page 27	Page 36	Page 36	Page 37	Page 37

Solid State Drive Solutions

Seagate is committed to the flash-based storage market, as is evident by its line of enterprise and client SSDs, engineered to deliver ultra-fast speed and high data integrity. Seagate is focused on the continuing technology leadership that allows it to be a premier supplier of both solid state drives and hard drives.



Legacy Name		1200 SSD	6X0 Pro SSD	6X0 SSD
Product Comparison	Description	Ultra-fast, consistent performance for demanding enterprise storage and server applications	Fast performance and low power for performance-hungry data center and cloud applications	Speed up your laptop with SSD performance and ruggedness
	Form Factor/z-Height	2.5-inch/7mm	2.5-inch/7mm	2.5-inch/5mm/7mm
	Reliability	0.44% AFR	0.58% AFR	0.58% AFR
	Capacity ¹	200GB to 800GB	100GB to 480GB	120GB to 480GB
	Endurance (total terabytes written over warranty period)	365,000TBW to 14,600,000TBW	24TBW to 10,800TBW	36.5TBW to 78TBW
	NAND Flash Type	MLC	MLC	MLC
Feature Comparison	Power (idle)	2.72W to 3.0W	1.05W to 1.25W	1.1W
	Interface	12Gb/s SAS	SATA 6Gb/s	SATA 6Gb/s
	Limited Warranty ⁴	5 years	5 years	3 years
	Product	1200 SSD	600 Pro SSD	600 SSD
	Self-Encrypting Drive (SED) Option ²	X		
	FIPS 140-2 SED Option ^{2,3}	X		
	Power Loss Data Protection	X	X	

1 One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.
2 Self-Encrypting Drive models may require TCG-compliant host or controller support.
3 Some FIPS in review. See FIPS 140-2 Label Certificate at http://csrc.nist.gov/groups/STM/workshop/documents/fips_140-2_label.htm.
4 Warranty terms may vary based on usage. Consult your Seagate sales representative for warranty terms and conditions.

1200 SSD

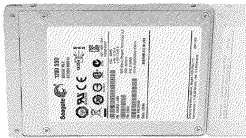
The Seagate 1200 SSD delivers best-in-class performance and a rich enterprise feature set for demanding data center applications.

Key Advantages

- Helps remove storage bottlenecks and close the gap between processor and data access performance
- Delivers the speed and performance consistency needed for demanding enterprise applications
- Designed to reduce data access wait times under the most complex, write-intensive workloads
- Ensures data availability for critical production systems by using redundant, failover I/O communication paths

Best-Fit Applications

- Demanding enterprise applications with complex, write-intensive and mixed workloads
- IOPS-hungry enterprise applications, such as high-performance computing, online transaction processing and heavy data analytics
- External enterprise storage solutions (SAN, NAS, DAS)



CAPACITY	MODEL	INTERFACE	NAND FLASH TYPE
800GB	ST800PM0033 ¹	SATA 12Gb/s	MLC
800GB	ST800PM0033 ²	SATA 12Gb/s	MLC
400GB	ST400PM0073 ³	SATA 12Gb/s	MLC
200GB	ST200PM0073 ³	SATA 12Gb/s	MLC

600 Pro SSD

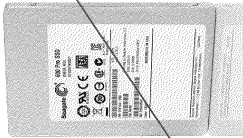
A class above client SSDs, Seagate 600 Pro SSDs deliver a best-in-class combination of fast, consistent performance and low power.

Key Advantages

- Delivers the highest IOPS/wait to improve system performance and reduce power and cooling costs for data center and cloud applications
- Fast, consistent performance and low latency over the warranty period of the drive
- Helps reduce performance gaps between storage I/O and CPU operations

Best-Fit Applications

- Data center applications (fast data indexing, edge caching)
- Data streaming
- Content delivery networks
- Gaming and software delivery
- Virtualization and other cloud applications



CAPACITY	MODEL	INTERFACE	NAND FLASH TYPE
480GB	ST480PF0021	SATA 6Gb/s	MLC
400GB	ST400PF0021	SATA 6Gb/s	MLC
240GB	ST240PF0021	SATA 6Gb/s	MLC
200GB	ST200PF0021	SATA 6Gb/s	MLC
120GB	ST120PF0021	SATA 6Gb/s	MLC
100GB	ST100PF0021	SATA 6Gb/s	MLC

600 SSD

The ultimate performance upgrade for existing laptops, the Seagate 600 SSD is a fast, rugged, 2.5-inch, SATA 6Gb/s solid state drive.

Key Advantages

- Nearly 4x faster boot times and over 2x faster application load times than typical laptop HDDs
- Significantly reduces the amount of time end users must wait before using their devices
- Allows end users to access data faster and to take advantage of superior laptop responsiveness
- The ultimate upgrade drive for road warriors, power users, executives and gamers—work and play faster

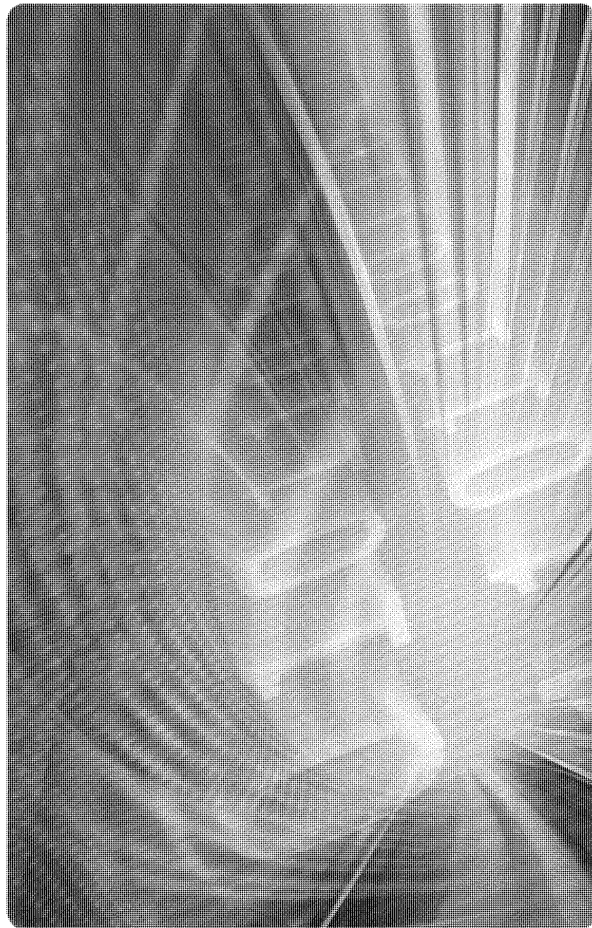
Best-Fit Applications

- Performance upgrade for existing laptops with 2.5-inch hard drives
- Improved ruggedness upgrade for existing laptops that may be dropped while operating
- Data center caching



CAPACITY	7MM Z-RT MODEL	INTERFACE	NAND FLASH TYPE
480GB	ST480ZM000	SATA 6Gb/s	MLC
240GB	ST240ZM000	SATA 6Gb/s	MLC
120GB	ST120ZM000	SATA 6Gb/s	MLC

CAPACITY	5MM Z-RT MODEL	INTERFACE	NAND FLASH TYPE
480GB	ST480ZM001	SATA 6Gb/s	MLC
240GB	ST240ZM001	SATA 6Gb/s	MLC
120GB	ST120ZM001	SATA 6Gb/s	MLC



¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes, when referring to drive capacity.
² See Seagate's Data Sheet for details on the 600 Pro SSD's performance and reliability.
³ IOPS: 140,000 in read; 30,000 in write. See IOPS at <http://www.seagate.com/SSD/Validation.html>



Legacy Name	ENTERPRISE TURBO SSHD	ENTERPRISE PERFORMANCE HDD	CHETAH®	ENTERPRISE CAPACITY HDD	TERACORE™ HDD CONSTELLATION® CS
	Sawto®				Constellation

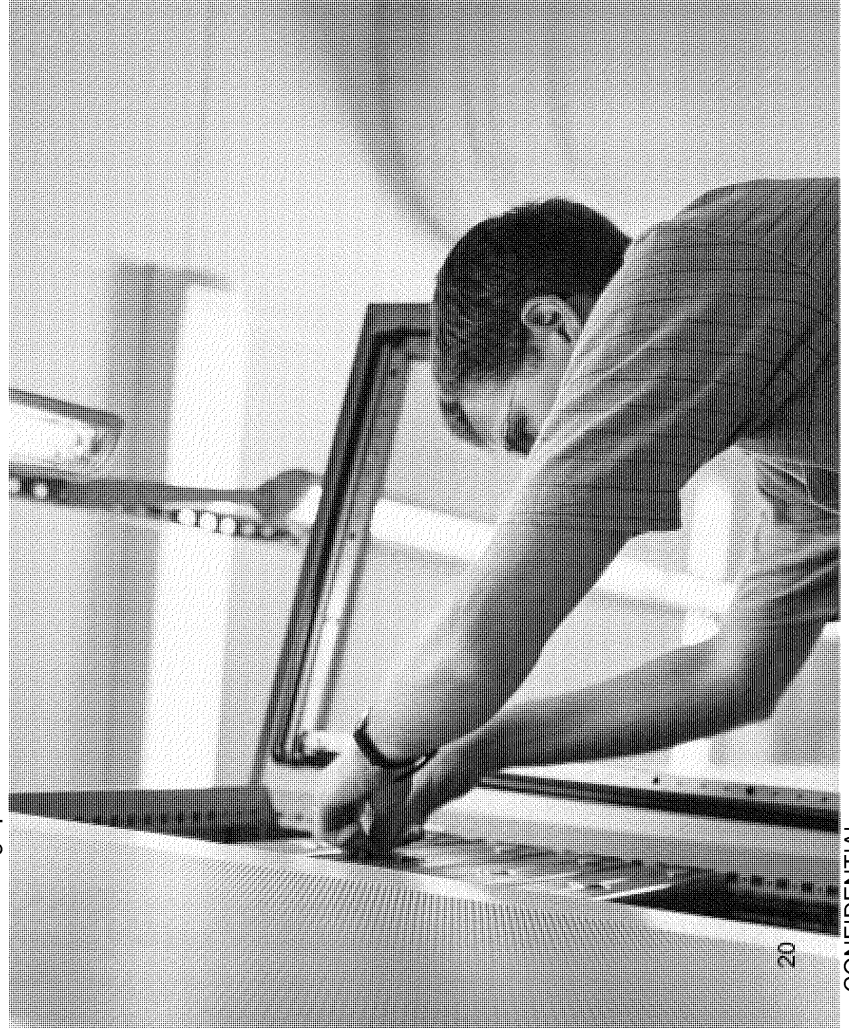
Application	Highest SFF Performance	SFF Performance and Mainstream	LF Performance	High Capacity and Low Power	Affordable High Capacity With Low Power
Description	World's fastest hard drive	Highest-performing, highly reliable 15K- and 10K-RPM enterprise hard drives in a 2.5-inch form factor	High-performance, legacy 15K-RPM enterprise hard drive in a 3.5-inch form factor	High-capacity, low-power, reliable 7200-RPM enterprise hard drive in both 2.5- and 3.5-inch form factors	High-capacity, eco-friendly, cost-effective storage for Web-scale data centers
Form Factor	2.5-inch	2.5-inch	3.5-inch	2.5-inch and 3.5-inch	3.5-inch
Reliability	0.44% AFR	0.44% AFR	0.55% AFR	0.62% and 1.09% AFR	800,000 MTBF
Capacity ¹	300GB to 900GB	300GB to 1200GB	300GB to 600GB	250GB to 4TB	1TB to 4TB
Power (idle)	4.83W to 5.3W	4.4W to 5.3W	8.74W to 11.68W	2.52W to 7.7W	up to 4.59W
Format	5x6E 4kN	512N, 5x6E, 4kN	512N	512N, 5x6E	512E
Interface	6Gb/s SAS	6Gb/s SAS, 6Gb/s FC	6Gb/s SAS, 6Gb/s FC	6Gb/s SAS, SATA 6Gb/s	SATA 6Gb/s
Limited Warranty ²	5 years	5 years	5 years	5 years	3 years

Product Comparison

Product	Enterprise Turbo SSHD	Enterprise Performance 15K HDD	Enterprise Performance 10K HDD	Chetah 15K	Enterprise Capacity 3.5 HDD	Teracore HDD Constellation CS
Vibration Tolerance for Multi-Drive Stabilization	X	X	X	X	X	X
PowerChoice™ Optimized Idle Power Settings	X	X	X	X	X	X
Self-Encrypting Drive (SED) ²	X	X	X	X	X	X
FIPS 140-2 SED Option ³	X	X	X	X	X	X
Instant Secure Erase	X	X	X	X	X	X
Solid State Hybrid	X					
Energy-Saving Features	X	X	X	X	X	X
RoHS Compliance	X	X	X	X	X	X

Feature Comparison

1 One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes, when referring to drive capacity.
 2 Self-Encrypting Drive models may require TCG-compliant host or controller support.
 3 Some FIPS in review. See FIPS 140-2 Limited Configuration at <http://csrc.nist.gov/groups/SST/NonCrypto/documents/fips-1402-limited.htm>.
 4 Warranty terms may vary based on usage. Contact your Seagate sales representative for warranty terms and conditions.



Enterprise Turbo SSHD

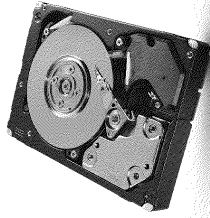
The Enterprise Turbo SSHD accelerates access to your most critical data with the world's fastest hard drive.

Key Advantages

- Hard drive capacities with flash-based performance
- Best economic combination of performance, endurance and capacity—best \$/IOPS enterprise HDD
- Meets critical demands for performance, scalability, flexibility and high density in a 2.5-inch form factor
- Automatically caches hot data to flash and absorbs write intensity by only promoting hot data
- Nonvolatile cache to enable faster write response time and help ensure data integrity during power loss

Best-Fit Applications

- Big data analytics
- Databases (ERP and OLTP)
- Virtual desktop infrastructure (VDI)
- Web development and Web page delivery



CAPACITY	5X EVALUATION MODEL	INTERFACE	CACHE
600GB	ST600MM004	63/s SAS	128MB
600GB	ST600MM014 ¹	63/s SAS	128MB
600GB	ST600MM024 ²	63/s SAS	128MB
450GB	ST450MM004	63/s SAS	128MB
450GB	ST450MM014 ¹	63/s SAS	128MB
300GB	ST300MM004	63/s SAS	128MB
300GB	ST300MM014 ¹	63/s SAS	128MB

CAPACITY	4K NATIVE MODEL	INTERFACE	CACHE
600GB	ST600MM004	63/s SAS	128MB
600GB	ST600MM014 ¹	63/s SAS	128MB
600GB	ST600MM054 ³	63/s SAS	128MB
450GB	ST450MM004	63/s SAS	128MB
450GB	ST450MM014 ¹	63/s SAS	128MB
300GB	ST300MM004	63/s SAS	128MB
300GB	ST300MM014 ¹	63/s SAS	128MB



Enterprise Performance 15K HDD

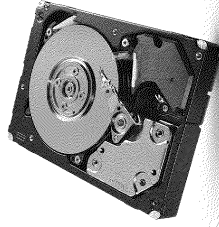
Seagate Enterprise Performance 15K HDDs leverage a 2.5-inch form factor to deliver pronounced performance advantages and power savings over legacy 3.5-inch drives.

Key Advantages

- Stores 2x the Tier 1 data over previous generation without increasing drive count
- Enables Tier 1 applications to process transactions more quickly
- Best-in-class idle power for more efficient storage operations
- Industry's highest MTBF at 2M hours
- Self-Encrypting Drive (SED)² and FIPS SED⁴ options cut IT drive retirement costs and help protect data at rest.

Best-Fit Applications

- High-performance Tier 1 enterprise servers
- Blade, rack and tower servers hosting transaction-based applications
- Power- and space-constrained data centers
- Compliance and data security initiatives



CAPACITY	5x NATIVE MODEL	INTERFACE	CACHE
450GB	ST450MP004	63/s SAS	128MB
450GB	ST450MP014 ¹	63/s SAS	128MB
300GB	ST300MP004	63/s SAS	128MB
300GB	ST300MP014 ¹	63/s SAS	128MB

CAPACITY	5x EVALUATION MODEL	INTERFACE	CACHE
600GB	ST600MP004	63/s SAS	128MB
600GB	ST600MP014 ¹	63/s SAS	128MB
600GB	ST600MP054 ^{2,4}	63/s SAS	128MB
450GB	ST450MP004	63/s SAS	128MB
450GB	ST450MP014 ¹	63/s SAS	128MB
300GB	ST300MP004	63/s SAS	128MB
300GB	ST300MP014 ¹	63/s SAS	128MB

CAPACITY	4K NATIVE MODEL	INTERFACE	CACHE
600GB	ST600MP064	63/s SAS	128MB
600GB	ST600MP074 ¹	63/s SAS	128MB
600GB	ST600MP084 ^{2,4}	63/s SAS	128MB
450GB	ST450MP064	63/s SAS	128MB
450GB	ST450MP074 ¹	63/s SAS	128MB
300GB	ST300MP064	63/s SAS	128MB
300GB	ST300MP074 ¹	63/s SAS	128MB

1 One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.
2 Self-Encrypting Drives (SED) and FIPS 140-2 validated drives are not available in all models or countries. May require TCO-compliant host or controller support. See FIPS 140-2 Level 2 Certificate at <http://www.seagate.com/enterprise/140-2-fips-cert>.
3 FIPS 140-2 Level 2 Certificate at <http://www.seagate.com/enterprise/140-2-fips-cert>.
4 FIPS 140-2 Level 2 Certificate at <http://www.seagate.com/enterprise/140-2-fips-cert>.

Enterprise Performance 10K HDD

Seagate Enterprise Performance 10K HDDs deliver the optimal balance of capacity, performance and power in a 10K-RPM, 2.5-inch enterprise drive.

Key Advantages

- Highest-capacity enterprise SFF hard drive (up to 1.2TB)
- PowerChoice™ technology reduces power consumption.
- Protection Information (PI) detects corruption of data in flight between the host system and the drive¹.
- Self-Encrypting Drive (SED)² and FIPS 140-2 certified SED³ cut IT drive retirement costs and protect data at rest. FIPS options meet government encryption compliance standards.

Best-Fit Applications

- Mission-critical servers and external storage arrays
- Power- and space-constrained data centers
- Compliance or data security initiatives



CAPACITY	5x NATIVE MODEL	INTERFACE	CACHE
1200GB	ST1200MM0017 ²	63/s SAS	64MB
1200GB	ST1200MM0027 ^{2,3}	63/s SAS	64MB
900GB	ST900MM0026 ²	63/s SAS	64MB
900GB	ST900MM0036 ^{2,3}	63/s SAS	64MB
900GB	ST900000055	63/s SAS	64MB
900GB	ST90070559 ²	63/s SAS	64MB
900GB	ST900000055 ^{2,3}	63/s SAS	64MB
900GB	ST900000FC	43/s FC	64MB
600GB	ST600MM0026 ²	63/s SAS	64MB
600GB	ST60002055	63/s SAS	64MB
600GB	ST90010559 ²	63/s SAS	64MB
600GB	ST900000055 ^{2,3}	63/s SAS	64MB
600GB	ST900020FC	43/s FC	64MB
450GB	ST450MM0026 ²	63/s SAS	64MB
450GB	ST94504055	63/s SAS	64MB
450GB	ST94500055 ²	63/s SAS	64MB
450GB	ST94502055 ^{2,3}	63/s SAS	64MB
450GB	ST945040FC	43/s FC	64MB
300GB	ST300MM0026 ²	63/s SAS	64MB
300GB	ST930000055	63/s SAS	64MB
300GB	ST930000055 ²	63/s SAS	64MB
300GB	ST93004055 ^{2,3}	63/s SAS	64MB
300GB	ST930000FC	43/s FC	64MB

Cheetah® 15K

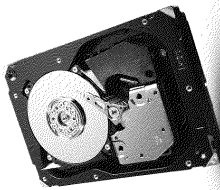
The Seagate Cheetah 15K drive provides high performance and reliability in legacy 3.5-inch mission-critical storage.

Key Advantages

- Sustained data rate of up to 204MB/s
- Industry's highest 3.5-inch drive reliability
- PowerTrim™ technology optimizes power consumption
- Self-Encrypting Drive (SED)² and FIPS 140-2 certified SED³ cut IT drive retirement costs and protect data. FIPS options meet government encryption compliance standards.

Best-Fit Applications

- Business and transaction processing
- Email and decision support
- Storage Area Networks (SAN)
- Network Attached Storage (NAS)
- Internet and e-commerce



CAPACITY	5x NATIVE MODEL	INTERFACE	CACHE
600GB	ST360067SS	63/s SAS	16MB
600GB	ST360067SS ²	63/s SAS	16MB
600GB	ST360067SS ^{2,3}	63/s SAS	16MB
600GB	ST360067FC	43/s FC	16MB
450GB	ST345067SS	63/s SAS	16MB
450GB	ST345067SS ²	63/s SAS	16MB
450GB	ST345067SS ^{2,3}	63/s SAS	16MB
450GB	ST345067FC	43/s FC	16MB
300GB	ST330067SS	63/s SAS	16MB
300GB	ST330067SS ²	63/s SAS	16MB
300GB	ST330047SS ^{2,3}	63/s SAS	16MB
300GB	ST330067FC	43/s FC	16MB

¹ One gigabyte (GB) equals one billion bytes and one terabyte (TB) equals one trillion bytes when referring to drive capacity.
² Self-Encrypting Drive (SED) and FIPS 140-2 validated drives are not available in all models or countries.
³ May require TCG-compliant host or controller support.
⁴ For more information, see <http://www.seagate.com>. All trademarks are the property of their respective owners. © 2014 Seagate Technology. All rights reserved.
⁵ For more information, see <http://www.seagate.com>.

Enterprise Capacity

3.5 HDD

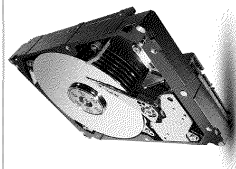
The Seagate Enterprise Capacity 3.5 HDDs help data centers meet the demanding growth of unstructured data.

Key Advantages

- Highest-capacity enterprise drive for maximum density
server and storage solutions
- SAS and SATA interfaces with 24x7 reliability
- Predictable 7200-RPM performance even in the most
rugged multi-drive environments
- Improved power and cooling efficiencies with low
power consumption and on-demand PowerChoice™
technology
- Protect your data and ease data disposal costs and
management with the Self-Encrypting Drive (SED) and
FIPS 140-2 certified SEDs.^{3,4}

Best-Fit Applications

- High-capacity RAID storage
- Mainstream enterprise external storage (SAN, NAS, DAS)
- Cloud bulk data storage



CACHE	INTERFACE	5xx NATIVE MODEL	CAPACITY
128MB	SATA 6Gb/s	ST4000NM0033	4TB
128MB	SATA 6Gb/s	ST4000NM0033 ²	4TB
128MB	SATA 6Gb/s	ST4000NM0079 ² ³	4TB
128MB	6Gb/s SAS	ST4000NM0023	4TB
128MB	6Gb/s SAS	ST4000NM0043 ²	4TB
128MB	6Gb/s SAS	ST4000NM0033 ²	4TB
128MB	SATA 6Gb/s	ST3000NM0033	3TB
128MB	SATA 6Gb/s	ST3000NM0033 ²	3TB
128MB	6Gb/s SAS	ST3000NM0023	3TB
128MB	6Gb/s SAS	ST3000NM0033 ² ³	3TB
128MB	SATA 6Gb/s	ST2000NM0033	2TB
128MB	SATA 6Gb/s	ST2000NM0033 ²	2TB
128MB	6Gb/s SAS	ST2000NM0023	2TB
128MB	6Gb/s SAS	ST2000NM0043 ²	2TB
128MB	6Gb/s SAS	ST2000NM0033 ² ³	2TB
128MB	SATA 6Gb/s	ST1000NM0033	1TB
128MB	SATA 6Gb/s	ST1000NM0033 ²	1TB
128MB	6Gb/s SAS	ST1000NM0023	1TB
128MB	6Gb/s SAS	ST1000NM0043 ²	1TB
128MB	6Gb/s SAS	ST1000NM0033 ² ³	1TB

Constellation®

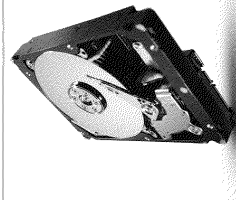
The Seagate Constellation drive is the only 2.5-inch enterprise-class hard drive delivering both 1TB capacities and enterprise reliability.

Key Advantages

- Maximizes data center footprint
- Energy-efficient storage at under 3.9W (idle)
- Highest nearline reliability with an MTBF of 1.4M hours
- Self-Encrypting Drive (SED)² and FIPS 140-2 certified SED³ cut IT drive retirement costs and protect data.
- FIPS options meet government encryption compliance standards.

Best-Fit Applications

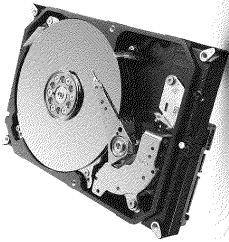
- Storage-hungry business applications
- Storage area networks and network attached storage
- Maximum-capacity servers and blade servers
- Rich media content storage
- Enterprise backup and restore—D2D, virtual tape
- Cloud computing



CAPACITY	5x5 NATIVE MODEL	INTERFACE	CACHE
1TB	ST91000640NS	SATA 6Gb/s	64MB
1TB	ST91000641NS ¹	SATA 6Gb/s	64MB
1TB	ST91000640S	SATA 6Gb/s	64MB
1TB	ST91000640SS	6Gb/s SAS	64MB
1TB	ST91000641SS ¹	6Gb/s SAS	64MB
1TB	ST91000642SS ¹	6Gb/s SAS	64MB
500GB	ST9500621NS	SATA 6Gb/s	64MB
500GB	ST9500621NS ¹	SATA 6Gb/s	64MB
500GB	ST9500622NS ²	SATA 6Gb/s	64MB
500GB	ST9500620S	6Gb/s SAS	64MB
500GB	ST9500621SS ¹	6Gb/s SAS	64MB
500GB	ST9500622SS ¹	6Gb/s SAS	64MB
500GB	ST9500610NS	SATA 6Gb/s	64MB
250GB	ST9250611NS ¹	SATA 6Gb/s	64MB
250GB	ST9250610NS ²	SATA 6Gb/s	64MB

Terascale™ HDD Constellation® CS

The Seagate Terascale HDD and Constellation CS are designed for large Web-scale data centers where low-cost, low-power and high-capacity storage is critical.



Key Advantages

- Affordable storage for 24x7 multi-drive replicated environments
- High vibration tolerance for reliable enterprise-class performance
- Low power and cooling costs with the lowest 3.5-inch enterprise drive operating power
- Advanced format logical block management for industry-leading data integrity

Best-Fit Applications

- Web-scale computing
- Cloud storage servers and arrays
- Cloud backup storage
- Direct-attached external storage (DAS)
- Network-attached storage (NAS)

CAPACITY	5w/EMULATION MODEL	INTERFACE	CACHE
4TB	ST4000NC000 ¹	SATA 6Gb/s	64MB
4TB	ST4000NC001	SATA 6Gb/s	64MB
3TB	ST3000NC002	SATA 6Gb/s	64MB
3TB	ST3000NC000 ²	SATA 6Gb/s	64MB
2TB	ST2000NC001	SATA 6Gb/s	64MB
2TB	ST2000NC000 ²	SATA 6Gb/s	64MB
1TB	ST1000NC001	SATA 6Gb/s	64MB
1TB	ST1000NC000 ²	SATA 6Gb/s	64MB



¹ One gigabyte is a GB equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.
² Seagate Inertial Secure Erase Model

Desktop Storage Solutions

Seagate has a distinguished history in consistently delivering innovative technologies, super-sized capacities, low power and blazing-fast performance. Seagate desktop drives offer excellent performance at all levels.



Desktop SSHD

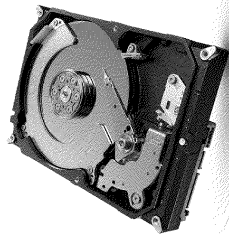
Seagate Desktop SSHD (solid state hybrid drive) delivers SSD-like performance and massive capacities at an affordable price.

Key Advantages

- First SSHD in a 3.5-inch form factor
- SATA 6Gb/s with NCQ for interface speed
- Up to 3x faster than a traditional HDD¹
- All-in-one design for ease of installation
- Installs and operates like a standard hard drive
- Massive 1TB or 2TB capacities combined with SSD-like performance²

Best-Fit Applications

- Desktop PCs
- Workstations
- High-performance direct-attached storage (DAS) devices



CAPACITY	MODEL	INTERFACE	CACHE
4TB	ST2000DX001	SATA 6Gb/s	64MB
2TB	ST12000DX001	SATA 6Gb/s	64MB
1TB	ST1000DX001	SATA 6Gb/s	64MB

Desktop HDD

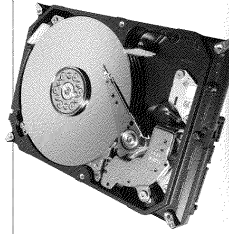
Seagate Desktop HDDs give you the Power of One with 1TB-per-disk technology and one drive platform for every capacity and application.

Key Advantages

- Up to 4TB capacity
- AcuTrac™ and OptiCache™ technologies deliver dependable overall performance.
- Free Seagate DiscWizard™ software

Best-Fit Applications

- Desktop or all-in-one PCs and home servers
- PC-based gaming systems
- Direct-attached external storage devices (DAS)



CAPACITY	MODEL	INTERFACE	CACHE
4TB	ST4000DM000	SATA 6Gb/s NCQ	64MB
3TB	ST3000DM001	SATA 6Gb/s NCQ	64MB
2TB	ST2000DM001	SATA 6Gb/s NCQ	64MB
1TB	ST1000DM003	SATA 6Gb/s NCQ	64MB
500GB	ST500DM002	SATA 6Gb/s NCQ	16MB
320GB	ST320DM000	SATA 6Gb/s NCQ	16MB
250GB	ST250DM000	SATA 6Gb/s NCQ	16MB

Desktop 3.5-Inch Internal Kit

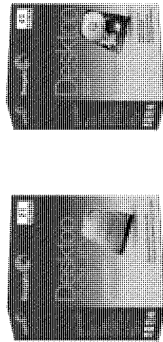
Seagate 3.5-inch internal drives are the fast, powerful, and easy way to upgrade or add storage capacity to desktop computers.

Key Advantages

- Quiet, ultra-high performance
- DiscWizard™ software makes installation a snap
- Built-in self-monitoring technology helps ensure maximum reliability
- Desktop solid state hybrid model offers SSD-like performance with the capacity of a hard drive

Best-Fit Applications

- Gaming PCs
- Workstations
- High-end PCs
- Desktop RAID
- Mainstream/office PCs

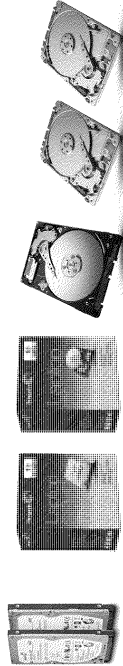


CAPACITY	KIT NUMBER ¹	INTERFACE	CACHE
4TB	STBD4000400	SATA 6Gb/s	64MB
3TB	STBD3000100	SATA 6Gb/s	64MB
2TB	STBD2000101	SATA 6Gb/s	64MB
1TB	STD1000SNA1AS-RK	SATA 6Gb/s	64MB
500GB	ST3500641AS-RK	SATA 3Gb/s	64MB
PACKAGE DIMENSIONS	7.38-in L x 5.88-in W x 2.88-in D (187mm x 149mm x 73mm)		

CAPACITY	KIT NUMBER	INTERFACE	CACHE
2TB	STCL2000400	SATA 6Gb/s	8GB
PACKAGE DIMENSIONS	5.88-in L x 7.38-in W x 2.88-in D (149.35mm x 187.45mm x 73.15mm)		



1 One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity. Actual capacity may vary slightly due to manufacturing tolerances. 2 Actual performance may vary depending on user's hardware configuration and operating system. 3 U.S. model numbers shown.



Mobile Storage Solutions

Seagate laptop and tablet drives address every mobile market need, delivering superior performance, reliability and value. Feature-rich with innovative options, the Seagate mobile lineup also includes self-encryption and FIPS 140-2 validated models.

Product Comparison

Legacy Name	Momentus XT	Momentus XT	Momentus Internal Kit	Application	Slim Computing	Slim Computing	Slim, Robust Computing
Description	The easy way to upgrade or add storage capacity to laptop computers to get solid state speed without sacrificing capacity	A complete upgrade kit to transform your system to high performance or just add capacity of a hard disk drive	The 2.5-inch drive for laptops and notebooks thinner than a pencil	Brings robust storage ideal for ultra-slim tablet, convertible and detachable applications in a 5mm form factor			
Capacity ¹	500GB and 1TB	500GB and 1TB	250GB and 1TB	250GB, 320GB and 500GB			500GB
Interface	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s			SATA 6Gb/s
Form Factor/ z-Height	2.5-inch/ 9.5mm, 7mm	2.5-inch/ 9.5mm, 7mm	2.5-inch/9.5mm	2.5-inch/7mm			2.5-inch/5mm
Reliability	0.48% AFR	0.48% AFR	0.48% AFR	0.48% AFR			
Cache	64MB	64MB	16MB	16MB			16MB
Power (Idle)	0.9W	0.9W	0.6W to 0.8W	0.43W			0.48W

Feature Comparison

Product	Laptop 3.5-inch and Laptop 7-inch HDD	Laptop 3.5-inch HDD	Laptop 2.5-inch Internal Kit	Momentus Thin	Momentus Ultra HDD
Self-Encrypting Drive (SED) with Instant Secure Erase ²				X	X
FIPS 140-2 SED Option ³				X	
Drop Sensor Options					X
Solid State Hybrid	X	X			
Compatible with Windows 8 ⁴	X	X	X	X	X
Energy-Saving Features	X	X	X	X	X
RoHS Compliance	X	X	X	X	X

¹ One gigabyte of GB equals one billion bytes and one terabyte of TB equals one trillion bytes when referring to drive capacity.
² Self-Encrypting Drive models may require TCG-compliant host or controller support.
³ Some FIPS 140-2 Level 2 Certified at <http://seagate.com/securestorage> 140-11401 and 140-11402.
⁴ For a complete list of Seagate products that are compatible with Windows 8, visit <http://www.microsoft.com/en-us/download/details.aspx?id=30654>

Laptop SSHD and Laptop Thin SSHD

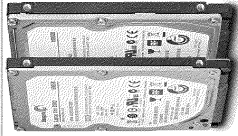
The Seagate Laptop SSHD (1TB) and Laptop Thin SSHD (500GB) enable laptop PC users to enjoy solid state performance without sacrificing capacity.

Key Advantages

- Boots and performs like an SSD²
- Up to 4x faster than a traditional HDD²
- SATA 6Gb/s with NCQ for interface speed
- All-in-one design for simplicity and ease of installation
- Works in any laptop or PC, any OS and any application
- Backed by a 3-year limited warranty

Best-Fit Applications

- Laptops and mobile workstations
- Desktop and tower workstations
- High-performance laptop and desktop gaming systems
- Small form factor all-in-one PCs



CAPACITY	MODEL	INTERFACE	CACHE
1TB	ST1000LM14	SATA 6Gb/s	64MB
500GB	ST500LM100	SATA 3Gb/s	64MB

Momentus® Thin

The 7mm, 2.5-inch drive enables slim computing for all types of mobile computing, from laptops to notebooks to smaller desktop PCs.

Key Advantages

- 7mm z-height form factor enables thin chassis design for all segments of laptop computing.
- Seagate SmartAlign™ technology provides a transition to 4K sectors without the need for software utilities.
- Self-Encrypting Drive³ options mitigate data breaches, comply with data protection regulations and preserve brand recognition.
- Self-Encrypting Drive options with FIPS 140-2 certification⁴ are government-approved for the U.S. and Canadian governments.

Best-Fit Applications

- Thin entry-level laptop PCs
- Thin high-end notebooks
- Thin ultraportables



CAPACITY	MODEL	INTERFACE	CACHE
500GB	ST500LT025 ⁵	SATA 6Gb/s	16MB
500GB	ST500LT015 ⁵	SATA 6Gb/s	16MB
500GB	ST500LT012	SATA 6Gb/s	16MB
320GB	ST320LT012	SATA 6Gb/s	16MB
250GB	ST250LT012	SATA 6Gb/s	16MB

Laptop Ultrathin HDD

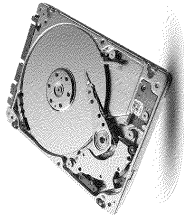
The Seagate Laptop Ultrathin HDD is one of the thinnest and lightest laptop hard drives—5mm, 3.3 oz. and thinner than a pencil.

Key Advantages

- Affordable, high-capacity storage gives system builder options when integrating low profile storage into slim laptop and ultrabook solutions
- Compatible with every portable PC with a standard SATA 6Gb/s interface
- Get industry-leading cost-per-GB and cost-per-millimeter
- Seagate Secure™ Self-Encrypting Drive options³

Best-Fit Applications

- Slim laptops or ultrabooks
- Extending high-capacity, affordable storage into other applications and slim devices
- Backup storage



CAPACITY	MODEL	INTERFACE	CACHE
500GB	ST500LT032	SATA 6Gb/s	16MB
500GB	ST500LT039	SATA 6Gb/s	16MB
320GB	ST320LT030	SATA 6Gb/s	16MB

Ultra Mobile HDD

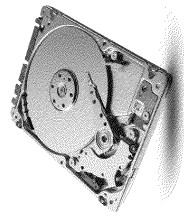
Just 5mm thin and supported by a stainless steel design, the Seagate Ultra Mobile HDD is ready for mobility.

Key Advantages

- 500GB brings 7x more space to tablet applications at a fraction of the cost.
- Zero-gravity sensors provide extra drop protection.
- Improved shock and tolerance for gyroscopic motion supports even the intense maneuvers of gamers.
- Just 3.3 oz.—about the weight of a lightbulb
- Couple with the Seagate Mobile Enablement Kit's Dynamic Data™ Driver for robust and responsive storage with no compromise to system battery life.

Best-Fit Applications

- Tablets
- Convertible and detachable storage
- Ultra-mobile, ultra-portable storage expansion apps



CAPACITY	MODEL	INTERFACE	CACHE
500GB	ST500LT035	SATA 6Gb/s	16MB

¹ One gigabyte (1 GB) equals one billion bytes and one terabyte (1 TB) equals one trillion bytes when referring to drive capacity.
² Performance may vary depending on user's hardware configuration and operating system. Testing performed on a Laptop SSHD 1TB and a Laptop Thin SSHD 500GB.
³ Self-Encrypting Drives (SEDs) are not available in all models or countries. May require TCG-compliant host or controller support.
⁴ FIPS 140-2 certification is available for the ST500LT035 and ST500LT039 models. For more information, please go to seagate.com/secure.
⁵ SmartAlign technology is not available on this model.

Laptop 2.5-Inch Internal Kit

Seagate 2.5-inch internal drives deliver vast amounts of storage for adding capacity or upgrading drives in laptop computers.

Key Advantages

- Built for mobility
- Preserves battery life
- Large data cache
- Outstanding performance
- Laptop solid state hybrid model offers SSD-like performance with the capacity of a hard drive.

Best-Fit Applications

- Replacement laptop drives
- Laptop storage upgrades
- High-end laptops and workstations



CAPACITY	KIT NUMBER	INTERFACE	QAGE
1TB	STBD1000100	SATA 3Gb/s	8MB
500GB	ST9050030A1AS-RK	SATA 3Gb/s	16MB
500GB	ST9050030N1AS-RK	SATA 3Gb/s	8MB
250GB	ST90250N1AS-RK	SATA 3Gb/s	8MB
PACKAGE DIMENSIONS	6.25-in L x 4.75-in W x 2.25-in D (159mm x 121mm x 57mm)		

LAPTOP 3.5-INCH HDD			
CAPACITY	KIT NUMBER	INTERFACE	ALC/FLASH
1TB	STBD1000400	SATA 6Gb/s	8GB
PACKAGE DIMENSIONS	6.25-in L x 4.75-in W x 2.25-in D (159mm x 121mm x 57mm)		

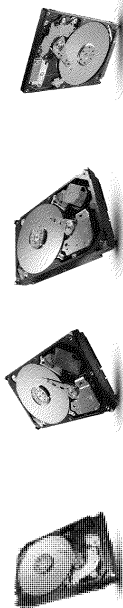


1 One gigabyte (GB) equals one billion bytes and one terabyte (TB) equals one trillion bytes when referring to drive capacity.
2 U.S. model numbers shown

Specialty Storage Solutions

Storage solutions for NAS, DVRs and surveillance systems

Seagate has the expertise to build drives optimized for specialty environments, like Network Attached Storage (NAS), CE and video storage. Our global presence, business partnerships, technology leadership and industry understanding enable Seagate to deliver industry-leading products.



Legacy Name				NAS HDD	SV35 SERIES™	VIDEO 3.5 HDD	PIPELINE HD Mini
Application				Small NAS	Video Surveillance	Mainstream CE-DVR	Small form factor CE-DVR
Description				Best-performing, highest-capacity storage for 1- to 5-bay NAS systems	Optimized performance and improved reliability for video surveillance applications	Cool, quiet, low-power performance—perfect for high-definition consumer DVR applications	Cool, quiet, low power—perfect for small form factor and power-sensitive designs
Capacity¹				2TB to 4TB	1TB to 3TB	250GB to 4TB	250GB to 500GB
Interface				SATA 6Gb/s	SATA 6Gb/s	SATA 3Gb/s, SATA 6Gb/s	SATA 3Gb/s
Form Factor				3.5-inch	3.5-inch	3.5-inch	2.5-inch
Simultaneous HD Streams Supported				—	—	up to 16	up to 12
Reliability				1M hours MTBF	<1% AFR	0.55% AFR	0.55% AFR
Cache				64MB	64MB	8MB to 64MB	16MB
Power (idle)				3.0W to 3.99W	3.36W to 5.4W (idle2)	2.3W to 5.0W	0.66W
Product				NAS HDD	SV35 Series	Video 3.5 HDD	Video 2.5 HDD
Cool Operation				x	x	x	x
24x7 Operation Capable				x	x	x	x
Extremely Low Vibration				x			
NASWorks™ Technology				x			
Energy-Saving Features				x		x	x
RoHS Compliance				x	x	x	x

Product Comparison

Feature Comparison

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.

NAS HDD

The Seagate NAS HDD fine-tunes the needs of 1- to 5-bay NAS systems to provide industry-leading performance and highest-capacity storage.

Key Advantages

- NASWorks™ technology supports custom error recovery controls, power management and vibration tolerance.
- NAS error recovery controls help to ensure drives are not dropped from the NAS and sent into a RAID rebuild.
- Improved vibration tolerance and emission in multi-drive systems with dual-plane balance
- Advanced power management supports multiple power profiles for low-power, 24x7 performance.

Best-Fit Applications

- Home servers or desktop NAS solutions
- Small-business file sharing
- Backup servers



CAPACITY	MODEL	INTERFACE	CACHE
4TB	ST4000/NX00	SATA 6Gb/s	64MB
3TB	ST3000/NX00	SATA 6Gb/s	64MB
2TB	ST2000/NX00	SATA 6Gb/s	64MB

SV35 Series™

The Seagate SV35 series drives optimize performance, save power and improve reliability for video surveillance applications.

Key Advantages

- Higher areal density for cost-effective DVR applications
- Performance-tuned for seamless video applications
- Enterprise-class reliability for 24x7 video surveillance applications
- Built-in error recovery for non-stop streaming

Best-Fit Applications

- Video surveillance digital video recorder
- Video surveillance network digital video recorder
- Direct-attached JBOD video surveillance storage
- Network-attached JBOD video storage



CAPACITY	MODEL	INTERFACE	CACHE
3TB	ST3000/VX00	SATA 6Gb/s	64MB
2TB	ST2000/VX00	SATA 6Gb/s	64MB
1TB	ST1000/VX00	SATA 6Gb/s	64MB

Video 3.5 HDD

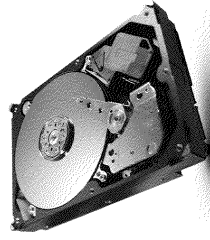
Seagate Video 3.5 HDDs deliver unprecedented levels of acoustic, power and vibration performance with room for hundreds of your favorite movies.

Key Advantages

- Quiet drive operation to enhance customer viewing and listening experiences
- 75°C, 24-hour operation capable
- Operational power consumption as low as 3.4W
- 2.0A spin-up current limited

Best-Fit Applications

- Consumer digital video recorders
- Media servers and centers
- Home theater PCs and servers
- Cable, satellite and IPTV set-top boxes



CAPACITY	MODEL	INTERFACE	CACHE
4TB	ST4000/M000	SATA 6Gb/s	64MB
3TB	ST3000/M002	SATA 6Gb/s	64MB
2TB	ST2000/M003	SATA 6Gb/s	64MB
1TB	ST1000/M002	SATA 6Gb/s	64MB
500GB	ST500012CS	SATA 3Gb/s	8MB
320GB	ST320011CS	SATA 3Gb/s	8MB
250GB	ST250012CS	SATA 3Gb/s	8MB

Video 2.5 HDD

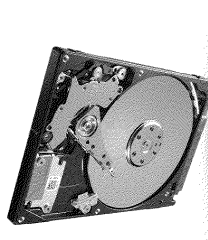
Seagate Video 2.5 HDDs let you stream, record and play back your video content with unparalleled reliability and performance.

Key Advantages

- Virtually silent streaming performance as low as 19dB
- Built for 24x7 operation and low power consumption
- Small, 2.5-inch form factor allows system cost reduction and operational power savings
- Fanless design allows flexibility in a sleek system design.
- 0.55% AFR supports longevity in demanding consumer electronic environments.

Best-Fit Applications

- DVR and media center applications
- Home theater PCs
- Karaoke and audio jukeboxes
- Cable, satellite and IPTV set-top boxes
- In-camera or surveillance systems



CAPACITY	MODEL	INTERFACE	CACHE
500GB	ST500VT000	SATA 3Gb/s	16MB
320GB	ST320VT000	SATA 3Gb/s	16MB
250GB	ST250VT000	SATA 3Gb/s	16MB

Partner Resources and Benefits

The Seagate Partner Program (SPP) provides access to unique resources and benefits to help channel partners secure new opportunities and grow revenue and profitability.

As a registered SPP member, you enjoy the following exclusive features:

- Password-protected portal
- E-newsletter and regular news updates
- New product evaluation unit program
- Training and sales tools
- Priority support

Start reaping the rewards of SPP membership—register today at www.seagate.com/www/partners

- Complete the online form.
- Click through and accept our standard agreement.



Service and Support

For information regarding products and services, visit www.seagate.com/about/contact-us/technical-support

Available services include:

- Presales and Technical Support
- Global Support Services telephone numbers and business hours
- Authorized Seagate Service Centers

For information regarding Warranty Support, visit www.seagate.com/support/warranty-and-returns

For information regarding Data Recovery Services, visit www.seagate.com/services-software/

For Seagate OEM and Distribution partner portal, visit www.seagate.com/www/partners

For Seagate reseller portal, visit www.seagate.com/www/partners





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Cupertino, California 95014
408-658-1000

FED_SEAG0004786**Metadata**

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EXHIBIT 20



Desktop

HARD DISK DRIVE KIT
Data Sheet

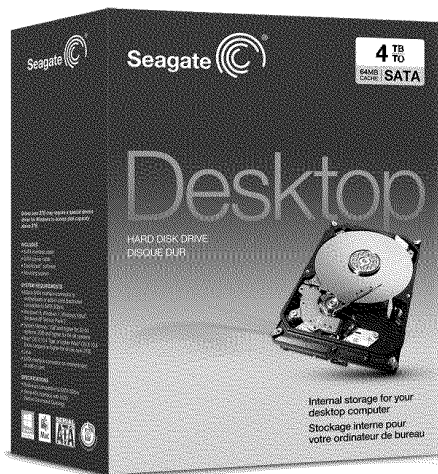
The Power of One

The Seagate® Desktop HDD (formerly Barracuda® hard drive) is the industry standard hard drive for mainstream desktop computing, delivering both exceptional reliability and performance. A host of refined technologies helps boost performance further than ever before. The Desktop HDD is perfect for desktop performance towers or all-in-one computers, consumer-grade NAS devices and desktop RAID arrays. In fact, the Desktop HDD gives you one hard drive platform for every desktop storage application. One drive with trusted performance, reliability and simplicity in capacities up to 4TB.

1TB-per-disk technology incorporates 340,000 unique tracks in the width of a single inch. This incredible storage density drives new capacity possibilities and lowers your total storage costs.

Perpendicular recording technology increases performance and reliability by aligning the data bits vertically on the disk. Additionally, Seagate OptiCache™ technology helps boost overall performance by as much as 45% over the previous generation, and Seagate AcuTrac™ technology provides reliable performance, even in tough environments. The free Seagate DiscWizard™ software allows you to install 3TB and 4TB hard drives in Windows, including XP, without UEFI BIOS.¹

¹ This high-capacity drive may require a special driver for Windows to access disk capacity above 2TB. Visit <http://www.seagate.com/beyond-2TB> for more information.





Desktop

HARD DISK DRIVE KIT

Specifications

Retail Packaging	Product Dimensions	Box Dimensions	Master Carton Dimensions	Pallet Dimensions
Length (in/mm)	5.75/146.05	5.88/149.35	6.5/165.1	48.0/1219.2
Width (in/mm)	4.0/101.6	7.38/187.45	16.0/406.4	40.0/1016
Depth (in/mm)	1.028/26.11	2.88/73.15	6.0/152.4	46.0/1168.4
Weight (lb/kg)	0.90/0.408	1.95/0.89	8.45/3.83	944.0/428.19
Quantities				
Boxes per Master Carton	4			
Master Cartons per Pallet	108			
Pallet Layers	6			
System Requirements				
Windows® 8, Windows 7, Windows Vista®, Windows XP Service Pack 3				
Power Mac® G5 and newer or Mac Pro® with Mac OS X 10.2 or higher				
Linux				
SATA interface connector on motherboard or add-in SATA card				
For Desktop HDD 3TB and 4TB models ¹				
6Gb/s SATA interface connector on motherboard or add-in card (backward compatible to SATA 3Gb/s)				
Windows 8, Windows 7, Windows Vista, Windows XP Service Pack 3				
System Memory: 1GB and higher for 32-bit systems; 2GB and higher for 64-bit systems				
Mac OS X 10.6 Snow Leopard or higher				
Linux				
Inside the Box				
Seagate® Desktop HDD (3.5-inch hard disk drive)		Mounting screws		
Interface cable		Quick installation guide		
Power cable		2-year limited warranty		

Region	Product	Capacity ²	Cache	Model Number	UPC Code	Multi-Pack UPC
EMEA	Seagate Desktop hard disk drive	1TB	64MB	ST310005N1D1AS-RK	7636490004407	10763649005849
EMEA	Seagate Desktop hard disk drive	2TB	64MB	STBD2000201	7636490031779	10763649033224
EMEA	Seagate Desktop hard disk drive	3TB ¹	64MB	STBD3000200	7636490031793	10763649033248
WW	Seagate Desktop hard disk drive	4TB ¹	64MB	STBD4000400	7636490043444	10763649044893

¹ This high-capacity drive may require a special driver for Windows to access disk capacity above 2TB. Visit <http://www.seagate.com/beyond-2TB> for more information.

² One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one thousand billion bytes when referring to drive capacity.

www.seagate.com

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 ASIA/PACIFIC Seagate Singapore International Headquarters Pte. Ltd. 7000 Ang Mo Kio Avenue 5, Singapore 569877, 65-6485-3888
 EUROPE, MIDDLE EAST AND AFRICA Seagate Technology SAS 16-18, rue du Dôme, 92100 Boulogne-Billancourt, France, 33 1-4186 10 00

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FED_SEAG0002109**Metadata**

Attach Counts	0	ORIGINAL
Confidentiality	Confidential	USER
Custodian	Allard_Kelly	ORIGINAL
DATECREATED	5/10/2013	ORIGINAL
DATELASTMOD	5/10/2013	ORIGINAL
DOEXT	pdf	ORIGINAL
DOCTYPE	Adobe Portable Document Format	ORIGINAL
FED_BEGATTACH	FED_SEAG0002106	ORIGINAL
FED_ENDATTACH	FED_SEAG0002110	ORIGINAL
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Relativity Image Count	2	ORIGINAL
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EXHIBIT 21

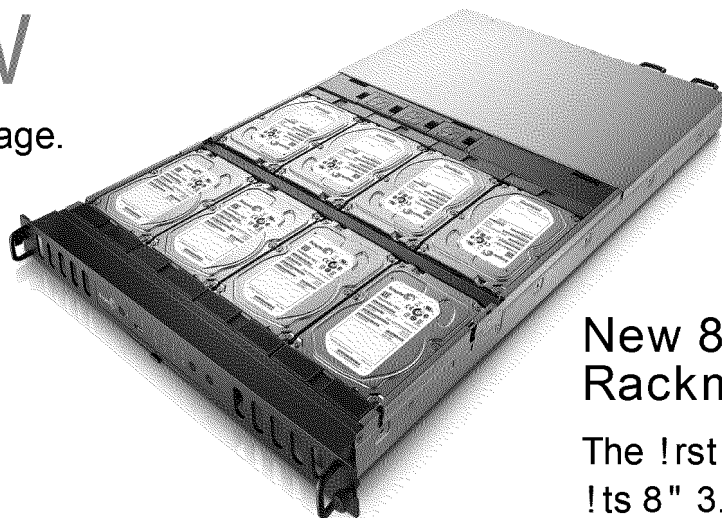


Storage Solutions Guide

OCTOBER 2013 | AMER

ROOM TO GROW

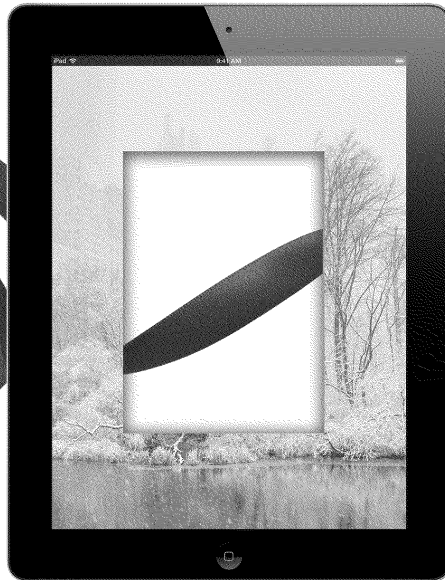
Double the storage.
Half the space.



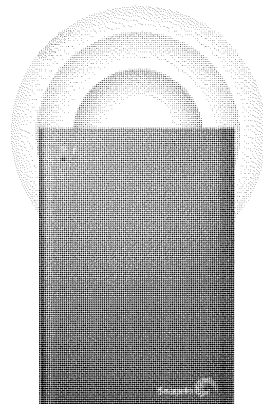
New 8-Bay Rackmount NAS

The first 1U rack that
fits 8" 3.5" drives

Make the perfect gift complete.



Complete your tablet with
1TB of storage to carry and stream 500+
movies or thousands of songs.
No internet required.



Wireless Plus
Mobile Device Storage



www.seagate.com

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External Storage

At-a-Glance Product Comparison

	BACKUP PLUS						SLIM		EXPANSION	
Direct Attached/ Portable										
	Backup Plus Portable	Backup Plus Portable for Mac	Backup Plus for Mac Portable Thunderbolt™	Backup Plus Desktop	Backup Plus Desktop for Mac	Backup Plus for Mac Desktop Thunderbolt	Slim Portable	Slim Portable for Mac	Expansion Portable	Expansion Desktop
PERFECT FOR	Protecting and sharing digital memories			Keeping your digital life safe and sound		Keeping your digital life safe and sound	Thin storage that fits—and goes—anywhere		Protecting and sharing your digital life	
DESCRIPTION	Store and back up the content on your social networks with these flexible, portable drives. PC or Mac.			These desktop drives provide the simple, one-click way to protect and share files. PC or Mac.		These desktop drives provide the simple, one-click way to protect and share files. Mac.	This ultra-thin metal design is the world's sleekest portable external hard drive. PC or Mac.		Expansion drives allow you to instantly add more storage space to your computer and take large files with you.	
LEARN MORE	Page 5	Page 6	Page 6	Page 8	Page 7	Page 7	Page 9	Page 8	Page 10	Page 9

Wireless Mobile										
	Wireless Plus									
PERFECT FOR	Wireless storage for your tablet	Centralized storage and backup				Centralized storage, collaboration and backup			Wireless centralized home storage	
DESCRIPTION	Take your media library on the go and stream it wirelessly to your iPad, Android tablet and smartphone. PC or Mac.	The first 1U rack that fits eight hot-swappable 3.5-inch drives		A complete, high-performance network storage for businesses with up to 100 employees		A complete network storage solution and private cloud for businesses of up to 50 employees.		A complete network storage solution and private cloud for businesses of up to 25 employees.		A complete network storage solution and private cloud for home of 100s.
LEARN MORE	Page 10	Page 11	Page 12	Page 12	Page 13	Page 13	Page 13	Page 13	Page 11	

External Storage Solutions

Seagate external storage solutions are sleek, dependable and ultra-portable products that let your customers automatically and continuously store digital family photos, protect critical business data, back up multiple computers on a small network, or share and store videos and music.

Backup Plus

The Backup Plus portable drive is the simple way to protect and share your entire digital life.

Key Advantages

- † Easy, flexible backups
- † Automatically saves photos from social networks
- † Photos and videos can be shared to social networks with a click.
- † Thunderbolt technology or FireWire 800 upgrade allows higher transfer speeds

Best-Fit Applications

- † Store or back up photos, movies, music and documents.
- † Download and save content that's posted on your social networks.
- † Share your digital memories to your social networks with a click.

CAPACITY	KIT NUMBER	INTERFACE	COLOR	OS
1TB	STBU1000100	USB 3.0	● Black	PC, Mac
1TB	STBU1000101	USB 3.0	● Silver	PC, Mac
1TB	STBU1000102	USB 3.0	● Blue	PC, Mac
1TB	STBU1000103	USB 3.0	● Red	PC, Mac
750GB	STBU750100	USB 3.0	● Black	PC, Mac
PRODUCT DIMENSIONS	4.86-in L x 3.19-in W x 0.57-in D (123.4mm x 81.1mm x 14.5mm)			
PACKAGE DIMENSIONS	5.2-in L x 1.81-in W x 6.54-in D (132mm x 46mm x 166mm)			



1 One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.
2 U.S. model numbers shown

STORAGE SOLUTIONS GUIDE

5

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Backup Plus for Mac

The Backup Plus portable drive for Mac is the simple way to protect and share your entire digital life.

Key Advantages

- † Mac OS and Time-Machine ready out of the box
- † Automatically saves photos from social networks
- † Share photos and video to social networks with a click.
- † Easily increase transfer speeds by upgrading to Thunderbolt technology.

Best-Fit Applications

- † Store or back up photos, movies, music and documents.
- † Download and save content that's posted on your social networks.
- † Share your digital memories to your social networks with a click.



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
1TB	STBM1000900	USB 3.0	● Silver/ ○ White	Mac, PC
PRODUCT DIMENSIONS	4.86-in L x 3.19-in W x 0.57-in D (123.4mm x 81.1mm x 14.5mm)			
PACKAGE DIMENSIONS	5.2-in L x 1.81-in W x 6.54-in D (132mm x 46mm x 166mm)			

Backup Plus Desktop for Mac

The Backup Plus desktop drive for Mac is the simple, one-click way to protect and share your entire digital life.

Key Advantages

- † Mac OS and Time Machine ready right out of the box
- † Automatically saves photos from social networks
- † Share photos and video to social networks with a click.
- † Up to 3TB capacity for a lifetime of memories

Best-Fit Applications

- † Back up all your important files.
- † Download and save content that's posted on your social networks.
- † Share your digital memories to your social networks with a click.



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
4TB	STCB4000901	USB 3.0	● Black/ ● Silver	Mac, PC
3TB	STCB3000900	USB 3.0	● Black/ ● Silver	Mac, PC
2TB	STCB2000900	USB 3.0	● Black/ ● Silver	Mac, PC
PRODUCT DIMENSIONS	6.22-in L x 4.88-in W x 1.73-in D (158mm x 124mm x 44mm)			
PACKAGE DIMENSIONS	7.87-in L x 9.06-in W x 3.54-in D (200mm x 230mm x 90mm)			

Backup Plus for Mac Portable Thunderbolt™

The Thunderbolt Backup Plus for Mac portable drive is everything you need to transfer, store and back up files using Thunderbolt technology.

Key Advantages

- † Includes Thunderbolt cable, adapter and drive
- † Compatible with Time Machine software
- † Compatible with Thunderbolt devices
- † No external power supply required

Best-Fit Applications

- † Combine high-speed data transfer and high-definition display in a single interface
- † Unleash your creativity using high-bandwidth media-capturing devices while processing in real time
- † Handle vast amounts of data more precisely than with any other connection
- † Back up and restore data at 10Gps



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
1TB	STBM1000401	Thunderbolt	● Black	Mac, PC
PRODUCT DIMENSIONS	5.12-in L x 3.19-in W x 1.09-in D (130mm x 81mm x 27.8mm)			
PACKAGE DIMENSIONS	6.69-in L x 5.24-in W x 1.81-in D (170mm x 133mm x 46mm)			

Backup Plus for Mac Desktop Thunderbolt

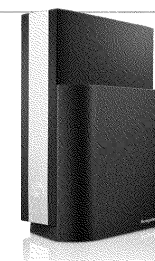
The Thunderbolt Backup Plus for Mac desktop drive is everything you need to transfer, store and back up files using Thunderbolt technology.

Key Advantages

- † Includes Thunderbolt cable, adapter and drive
- † Dual ports enable daisy-chaining up to six devices
- † Compatible with Thunderbolt displays and other devices
- † Compatible with Time Machine software

Best-Fit Applications

- † Combine high-speed data transfer and high-definition display in a single interface
- † Unleash your creativity using high-bandwidth media-capturing devices while processing in real time
- † Handle vast amounts of data more precisely than with any other connection
- † Back up and restore data at 10Gbps



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
3TB	STCB3000400	Thunderbolt	● Black	Mac, PC
PRODUCT DIMENSIONS	6.61-in L x 4.76-in W x 2.42-in D (168mm x 120.9mm x 61.4mm)			
PACKAGE DIMENSIONS	8.64-in L x 9.13-in W x 3.5-in D (219.5mm x 232mm x 89mm)			

Backup Plus Desktop

The Backup Plus desktop drive is the simple, one-click way to protect and share your entire digital life.

Key Advantages

- † Easy, flexible, built-in backup options
- † Automatically saves photos from social networks
- † Photos and videos can be shared to social networks with a click.
- † Up to 4TB capacity for a lifetime of memories
- † Increase transfer speeds by upgrading to Thunderbolt technology or FireWire 800.

Best-Fit Applications

- † Back up all your important files.
- † Download and save content that's posted on your social networks.
- † Share your digital memories to your social networks with a click.



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
4TB	STCA4000100	USB 3.0	● Black	PC, Mac
3TB	STCA3000101	USB 3.0	● Black	PC, Mac
2TB	STCA2000100	USB 3.0	● Black	PC, Mac
1TB	STCA1000100	USB 3.0	● Black	PC, Mac
PRODUCT DIMENSIONS	6.22-in L x 4.88-in W x 1.73-in D (158mm x 124mm x 44mm)			
PACKAGE DIMENSIONS	7.87-in L x 9.06-in W x 3.54-in D (200mm x 230mm x 90mm)			

Slim

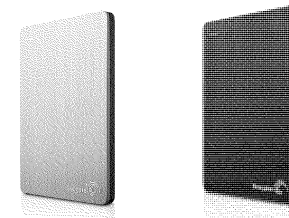
The Seagate Slim portable drive is thin, light and the easiest way yet to back up the things that are important to you.

Key Advantages

- † Just slightly thicker than an iPhone
- † Protects your stuff with easy, flexible backups
- † Automatically saves photos from social networks
- † Photos and videos can be shared to social networks with a click.

Best-Fit Applications

- † Store or back up photos, movies, music and documents.
- † Download and save content that's posted on your social networks.
- † Share your digital memories to your social networks with a click.



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
500GB	STCD500102	USB 3.0	● Black	PC, Mac
500GB	STCD500104	USB 3.0	● Silver	PC, Mac
PRODUCT DIMENSIONS	4.47-in L x 2.99-in W x 0.38-in D (113.5mm x 76mm x 9.6mm)			
PACKAGE DIMENSIONS	5.59-in L x 1.22-in W x 4.06-in D (142mm x 31mm x 103mm)			

Slim for Mac

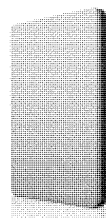
The Seagate Slim portable drive for Mac combines a thin, light form factor in a Time Machine-ready drive.

Key Advantages

- † Just slightly thicker than an iPhone
- † Mac OS and Time Machine ready out of the box
- † Automatically saves photos from social networks
- † Photos and videos can be shared to social networks with a click.

Best-Fit Applications

- † Store or back up photos, movies, music and documents.
- † Download and save content that's posted on your social networks.
- † Share your digital memories to your social networks with a click.



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
500GB	STCF500102	USB 3.0	● Silver	Mac, PC
PRODUCT DIMENSIONS	4.47-in L x 2.99-in W x 0.38-in D (113.5mm x 76mm x 9.6mm)			
PACKAGE DIMENSIONS	5.59-in L x 1.22-in W x 4.06-in D (142mm x 31mm x 103mm)			

Expansion

The Expansion desktop drive provides extra storage for your ever-growing collection of files.

Key Advantages

- † Simple and straightforward setup
- † No software to install and nothing to configure
- † Saving files is easy—simply drag and drop.
- † USB 3.0 interface allows fast transfer speeds.

Best-Fit Applications

- † Instantly add more storage space to your computer.
- † Improve performance on your computer's internal drive by freeing up space on your internal drive.



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
4TB	STB/4000100	USB 3.0	● Black	PC
3TB	STB/3000100	USB 3.0	● Black	PC
2TB	STB/2000100	USB 3.0	● Black	PC
1TB	STB/1000100	USB 3.0	● Black	PC
PRODUCT DIMENSIONS	7.07-in L x 4.65-in W x 1.48-in D (179.5mm x 118mm x 37.5mm)			
PACKAGE DIMENSIONS	9.09-in L x 7.97-in W x 2.83-in D (231mm x 202mm x 72mm)			

Expansion

The Expansion portable drive is compact and perfect for taking large files with you on-the-go.

Key Advantages

- † Simple and straightforward setup
- † Powered from the USB cable
- † Saving files is easy—simply drag and drop.
- † USB 3.0 interface allows fast transfer speeds.

Best-Fit Applications

- † Instantly add more storage space to your computer.
- † Take large files with you when you travel.



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
1TB	STBX1000101	USB 3.0	● Black	PC
750GB	STBX750100	USB 3.0	● Black	PC
500GB	STBX500100	USB 3.0	● Black	PC
PRODUCT DIMENSIONS (1TB)	5.04-in L x 3.51-in W x 0.87-in D (128.1mm x 89.1mm x 22mm)			
PRODUCT DIMENSIONS (500GB)	4.81-in L x 3.19-in W x 0.61-in D (122.3mm x 81.1mm x 15.5mm)			
PACKAGE DIMENSIONS	5.28-in L x 6.69-in W x 1.89-in D (134mm x 170mm x 48mm)			

Central

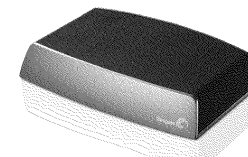
The Central shared network storage system allows you to create secure in-home cloud storage for multiple computers in the home.

Key Advantages

- † Automatically back up multiple PC and Mac computers
- † Wirelessly stream your centralized media library to gaming consoles, media players and smart TVs
- † Access content on-the-go with a Web browser or the free app for tablets and smartphones

Best-Fit Applications

- † Consolidate content on one easily accessible device
- † Back up multiple PC and Mac computers
- † Enjoy a centralized media library on smart TVs, game consoles and media players
- † Access your content on-the-go with laptops and mobile devices
- † Archive your Facebook photos and videos



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
4TB	STCG4000100	SATA/GigE	● Black	PC, Mac
3TB	STCG3000100	SATA/GigE	● Black	PC, Mac
2TB	STCG2000100	SATA/GigE	● Black	PC, Mac
PRODUCT DIMENSIONS	5.7-in L x 8.5-in W x 1.7-in D (145mm x 216mm x 42mm)			
PACKAGE DIMENSIONS	3.15-in L x 10.3-in W x 9.25-in D (80mm x 261mm x 235mm)			

Wireless Plus

With Wireless Plus mobile device storage, you can take your media library with you. Stream it to your iPad or Android tablet.

Key Advantages

- † Take your media library with you on the go
- † Share media with up to eight Wi-Fi enabled devices at the same time
- † Use anywhere, without an Internet connection
- † Up to 10 hours battery life³

Best-Fit Applications

- † Store and carry movies and other media on the go.
- † Share media with others.
- † Works with iPad or Android tablets and smartphones



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
1TB	STCK1000100	USB 3.0	● Grey	PC, Mac
PRODUCT DIMENSIONS	5.00-in L x 3.50-in W x 0.78-in D (127mm x 89mm x 19.9mm)			
PACKAGE DIMENSIONS	2.00-in L x 6.02-in W x 7.16-in D (51mm x 153mm x 182mm)			

Business Storage 8-Bay Rackmount NAS

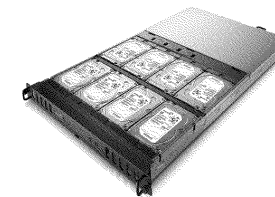
A complete network storage solution with innovative 8-bay design in a 1U form factor that is perfect for growing businesses

Key Advantages

- † A 2.3GHz dual-core Intel processor delivers file transfer performance of up to 200MB/s
- † Wuala™ cloud service and apps for secure collaboration and anywhere access
- † Centralized backup for PCs, plus Time Machine support for Mac computers
- † Support for iSCSI enables maximum performance and compatibility for virtualized environments

Best-Fit Applications

- † Store business-critical files centrally and securely
- † Back up your organization's PC and Mac computers
- † Access and manage files remotely using Internet-connected computers and devices
- † Back up files to the cloud



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
32TB	STDP32000100	Gigabit Ethernet	Black	PC, Mac
24TB	STDP24000100	Gigabit Ethernet	Black	PC, Mac
16TB	STDP16000100	Gigabit Ethernet	Black	PC, Mac
12TB	STDP12000100	Gigabit Ethernet	Black	PC, Mac
8TB	STDP8000100	Gigabit Ethernet	Black	PC, Mac
PRODUCT DIMENSIONS	30.394-in L x 1.713-in W x 18.78-in D (772mm x 43.5mm x 477mm)			
PACKAGE DIMENSIONS	35.354-in L x 23.465-in W x 8.661-in D (898mm x 596mm x 220mm)			

Business Storage 4-Bay Rackmount NAS

Centralize your storage and backups with a complete network storage solution that saves valuable "oor space for small businesses.

Key Advantages

- † Centralized storage and backup for PCs and Macs, plus secure Wuala cloud off-site backup service
- † A dual-core Intel Atom processor and new, performance-optimized Seagate NAS OS deliver 1!e transfer speeds up to 200MB/s
- † Anywhere access to your 1!es
- † Hot-swappable drives and dual Gigabit Ethernet ports help increase up-time

Best-Fit Applications

- † Store business-critical 1!es centrally and securely
- † Back up your organization's PC and Mac computers
- † Access and manage 1!es remotely using Internet-connected computers and devices
- † Back up 1!es to the cloud



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
16TB	STDN16000100	Gigabit Ethernet	● Black	PC, Mac
12TB	STDN12000100	Gigabit Ethernet	● Black	PC, Mac
8TB	STDN8000100	Gigabit Ethernet	● Black	PC, Mac
4TB	STDN4000100	Gigabit Ethernet	● Black	PC, Mac
—	STDN100	Gigabit Ethernet	● Black	PC, Mac
PRODUCT DIMENSIONS	16.929-in L x 15-in W x 1.713-in D (430mm x 381mm x 42.5mm)			
PACKAGE DIMENSIONS	22.44-in L x 19.567-in W x 6.496-in D (570mm x 497mm x 164mm)			

Business Storage 2-Bay NAS

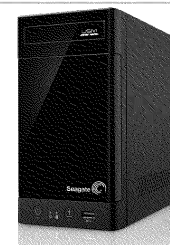
Create a private cloud to help protect your business-critical data and centralize 1!es in a single location you can access from anywhere

Key Advantages

- † Easy 10-minute setup
- † Upload and download 1!es with free apps for iPhone, iPad and Android devices
- † Full-system, automatic backup for PCs, plus Time Machine support for Mac computers
- † Customize performance and data redundancy with RAID 0 and 1 configuration options

Best-Fit Applications

- † Make automatic, continuous backups of multiple PC and Mac computers
- † Store 1!es in a secure, central location
- † Access and manage 1!es remotely using Internet-connected computers, tablets and smartphones
- † Create cost-effective, private cloud storage



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
8TB	STBN8000100	Gigabit Ethernet	● Black	PC, Mac
6TB	STBN6000100	Gigabit Ethernet	● Black	PC, Mac
4TB	STBN4000100	Gigabit Ethernet	● Black	PC, Mac
—	STBN100	Gigabit Ethernet	● Black	PC, Mac
PRODUCT DIMENSIONS	4.1-in W x 8.0-in H x 8.9-in D (104.50mm x 204.00mm x 227.00mm)			
PACKAGE DIMENSIONS	6.2-in W x 10.9-in H x 12.5-in D (157.00mm x 277.00mm x 317.00mm)			

Business Storage 4-Bay NAS

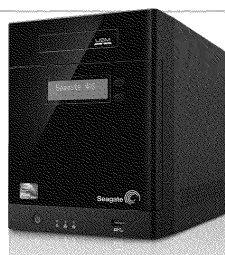
A complete, small-business-specific network storage solution designed to provide optimum uptime and data integrity for up to 50 workstations

Key Advantages

- † Easy 10-minute setup
- † Upload and download 1!es with free apps for iPhone, iPad and Android devices
- † Full-system, automatic backup for PCs, plus Time Machine support for Mac computers
- † Customize performance and data redundancy with RAID 0, 1, 5 and 10 configuration options

Best-Fit Applications

- † Make automatic, continuous backups
- † Store 1!es in a secure, central location
- † Access and manage 1!es remotely using Internet-connected devices
- † Create cost-effective, private cloud storage
- † Encrypt individual 1!es to entire volumes of data



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
16TB	STBP16000100	Gigabit Ethernet	● Black	PC, Mac
12TB	STBP12000100	Gigabit Ethernet	● Black	PC, Mac
8TB	STBP8000100	Gigabit Ethernet	● Black	PC, Mac
4TB	STBP4000100	Gigabit Ethernet	● Black	PC, Mac
—	STBP100	Gigabit Ethernet	● Black	PC, Mac
PRODUCT DIMENSIONS	6.3-in W x 8.2-in H x 10.2-in D (161.00mm x 208.00mm x 258.50mm)			
PACKAGE DIMENSIONS	9.4-in W x 14.9-in H x 9.4-in D (240.00mm x 379.00mm x 243.00mm)			

Business Storage 1-Bay NAS

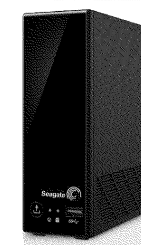
Create a private cloud with Seagate Business Storage 1-Bay NAS. It helps protect your all-important data and centralizes your 1!es in a single location you can access from anywhere.

Key Advantages

- † Easy 10-minute setup
- † Upload and download 1!es with free apps for iPhone, iPad and Android devices
- † Full-system, automatic backup for PCs, plus Time Machine support for Mac computers
- † Stream your media library to networked computers, Internet TVs, game consoles and more

Best-Fit Applications

- † Make automatic, continuous backups of multiple PC and Mac computers
- † Store 1!es in a secure, central location
- † Access and manage 1!es remotely using Internet-connected computers, tablets and smartphones
- † Create cost-effective, private cloud storage



CAPACITY ¹	KIT NUMBER ²	INTERFACE	COLOR	OS
4TB	STBM4000100	Gigabit Ethernet	● Black	PC, Mac
3TB	STBM3000100	Gigabit Ethernet	● Black	PC, Mac
2TB	STBM2000100	Gigabit Ethernet	● Black	PC, Mac
PRODUCT DIMENSIONS	2.4-in W x 6.9-in H x 5.8-in D (61mm x 176mm x 148mm)			
PACKAGE DIMENSIONS	3.7-in W x 9.3-in H x 9.0-in D (93mm x 236mm x 229mm)			

Internal Storage

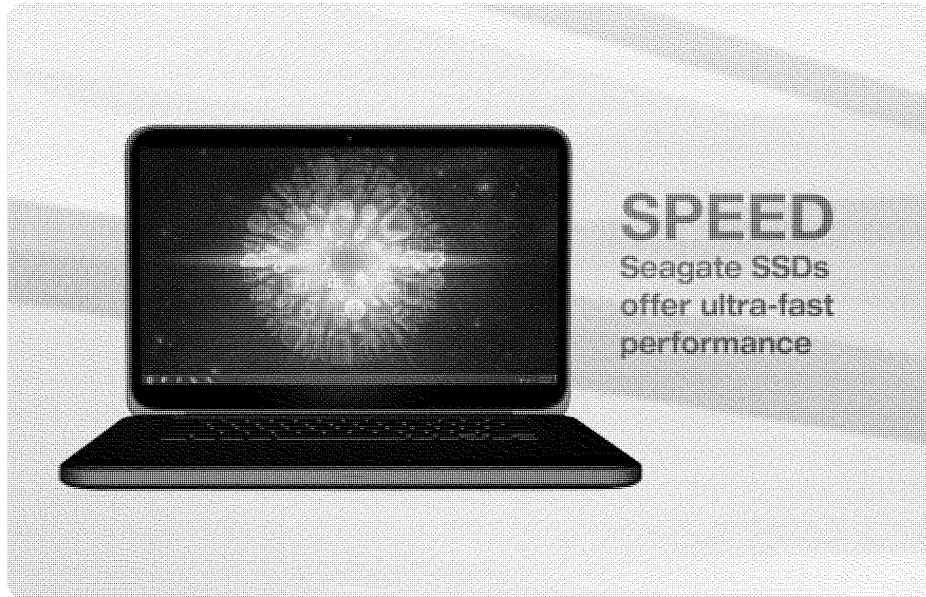
At-a-Glance Product Comparison

ENTERPRISE				DESKTOP		SPECIALTY					
3.5-inch											
	Cheetah® 15K	Enterprise Capacity 3.5 HDD	TeraScale™ HDD	Desktop SSHD	Desktop HDD	NAS HDD	Surveillance HDD	Video 3.5 HDD			
	USE THIS DRIVE FOR	High-capacity, compute-intensive requirements demanding high performance and availability	Bulk-data applications requiring reliable, highest-capacity storage efficiency and enterprise-class reliability	Cost-effective, low-power bulk storage solutions for unstructured data	Desktop solutions requiring SSD-like performance and massive capacities at an affordable price	Desktop compute where choice in capacity and cache options to provide design flexibility is important	Small NAS systems needing performance with high capacities. 3-year limited warranty	Surveillance systems that require high performance, low-power and centralized storage in every surveillance application. 3-year limited warranty	DVR systems where reliable, low-power, purpose-built storage is required for video streaming applications. 3-year limited warranty		
	ENCRYPTION MODELS AVAILABLE	X	X								
LEARN MORE				Page 25	Page 26	Page 28	Page 32	Page 32	Page 42	Page 42	Page 43

SSD			ENTERPRISE SSHD		ENTERPRISE			MOBILE			SPECIALTY				
2.5-inch															
	1200 SSD	600 Pro SSD	600 SSD	Enterprise Turbo SSHD	Enterprise Performance 15K HDD	Enterprise Performance 10K HDD	Constellation®	Laptop SSHD and Laptop Thin SSHD	Momentus™ Thin	Laptop Ultrathin HDD	Ultra Mobile HDD	Video 2.5 HDD			
	USE THIS DRIVE FOR	Enterprise storage environments requiring high-capacity SSD with data integrity and drive endurance	Data center and cloud applications that require fast performance and low power	On-the-go users who need the fastest performance and improved ruggedness	Improved storage performance tier between SSDs and high-capacity HDDs	Compute-intensive data requirements demanding the highest HDD performance density and availability	Mainstream data requiring high capacity, performance density and reliability	Online reference data demands requiring cost-effective, low-power, enterprise-class drives	The ultimate mobile computing experience, with SSD-like performance for all applications and OS environments	Slim computing devices, such as laptops and netbooks	Slim laptops and devices that need light, affordable, high-capacity storage	Robust storage for high-capacity tablets and mobile applications	Video streaming where 24x7 operation, small form factor and low power consumption are needed, 3-year limited warranty		
	ENCRYPTION MODELS AVAILABLE			X	X	X	X	X		X	X				
LEARN MORE				Page 18	Page 18	Page 19	Page 22	Page 22	Page 24	Page 27	Page 36	Page 36	Page 37	Page 37	Page 43

Solid State Drive Solutions

Seagate is committed to the #ash-based storage market, as is evident by its line of enterprise and client SSDs, engineered to deliver ultra-fast speed and high data integrity. Seagate is focused on the continuing technology leadership that allows it to be a premier supplier of both solid state drives and hard drives.



1200 SSD

600 Pro SSD

600 SSD

Product Comparison	Legacy Name			
	Description	Ultra-fast, consistent performance for demanding enterprise storage and server applications	Fast performance and low power for performance-hungry data center and cloud applications	Speed up your laptop with SSD performance and ruggedness
	Form Factor/z-Height	2.5-inch/7mm	2.5-inch/7mm	2.5-inch/5mm, 7mm
	Reliability	0.44% AFR	0.58% AFR	0.58% AFR
	Capacity ¹	200GB to 800GB	100GB to 480GB	120GB to 480GB
	Endurance (total terabytes written over warranty period)	3650TBW to 14,600TBW	24TBW to 1080TBW	36.5TBW to 73TBW
	NAND Flash Type	MLC	MLC	MLC
	Power (Idle)	2.73W to 3.0W	1.05W to 1.25W	1.1W
	Interface	12Gb/s SAS	SATA 6Gb/s	SATA 6Gb/s
	Limited Warranty ⁴	5 years	5 years	3 years
Feature Comparison	Product	1200 SSD	600 Pro SSD	600 SSD
	Self-Encrypting Drive (SED) Option ²	X		
	FIPS 140-2 SED Option ^{2,3}	X		
	Power Loss Data Protection	X	X	

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.

² Self-Encrypting Drive models may require TCG-compliant host or controller support.

³ Some FIPS in review. See FIPS 140-2 Level 2 Cert1 date at <http://csrc.nist.gov/groups/STM/cmp/documents/140-1/1401vend.htm>.

⁴ Warranty terms may vary based on usage. Consult your Seagate sales representative for warranty terms and conditions.

1200 SSD

The Seagate 1200 SSD delivers best-in-class performance and a rich enterprise feature set for demanding data center applications.

Key Advantages

- † Helps remove storage bottlenecks and close the gap between processor and data access performance
- † Delivers the speed and performance consistency needed for demanding enterprise applications
- † Designed to reduce data access wait times under the most complex, write-intensive workloads
- † Ensures data availability for critical production systems by using redundant, failover I/O communication paths

Best-Fit Applications

- † Demanding enterprise applications with complex, write-intensive and mixed workloads
- † IOPS-hungry enterprise applications, such as high-performance computing, online transaction processing and heavy data analytics
- † External enterprise storage solutions (SAN, NAS, DAS)



CAPACITY ¹	MODEL	INTERFACE	NAND FLASH TYPE
800GB	ST800FM0053 ²	SATA 12Gb/s	MLC
800GB	ST800FM0063 ^{2,3}	SATA 12Gb/s	MLC
400GB	ST400FM0073 ²	SATA 12Gb/s	MLC
200GB	ST200FM0073 ²	SATA 12Gb/s	MLC

600 SSD

The ultimate performance upgrade for existing laptops, the Seagate 600 SSD is a fast, rugged, 2.5-inch, SATA 6Gb/s solid state drive.

Key Advantages

- † Nearly 4" faster boot times and over 2" faster application load times than typical laptop HDDs
- † Significantly reduces the amount of time end users must wait before using their devices
- † Allows end users to access data faster and to take advantage of superior laptop responsiveness
- † The ultimate upgrade drive for road warriors, power users, executives and gamers—work and play faster

Best-Fit Applications

- † Performance upgrade for existing laptops with 2.5-inch hard drives
- † Improved ruggedness upgrade for existing laptops that may be dropped while operating
- † Data center caching



CAPACITY	7MM Z-HT MODEL	INTERFACE	NAND FLASH TYPE
480GB	ST480HM000	SATA 6Gb/s	MLC
240GB	ST240HM000	SATA 6Gb/s	MLC
120GB	ST120HM000	SATA 6Gb/s	MLC

CAPACITY	5MM Z-HT MODEL	INTERFACE	NAND FLASH TYPE
480GB	ST480HM001	SATA 6Gb/s	MLC
240GB	ST240HM001	SATA 6Gb/s	MLC
120GB	ST120HM001	SATA 6Gb/s	MLC

600 Pro SSD

A class above client SSDs, Seagate 600 Pro SSDs deliver a best-in-class combination of fast, consistent performance and low power.

Key Advantages

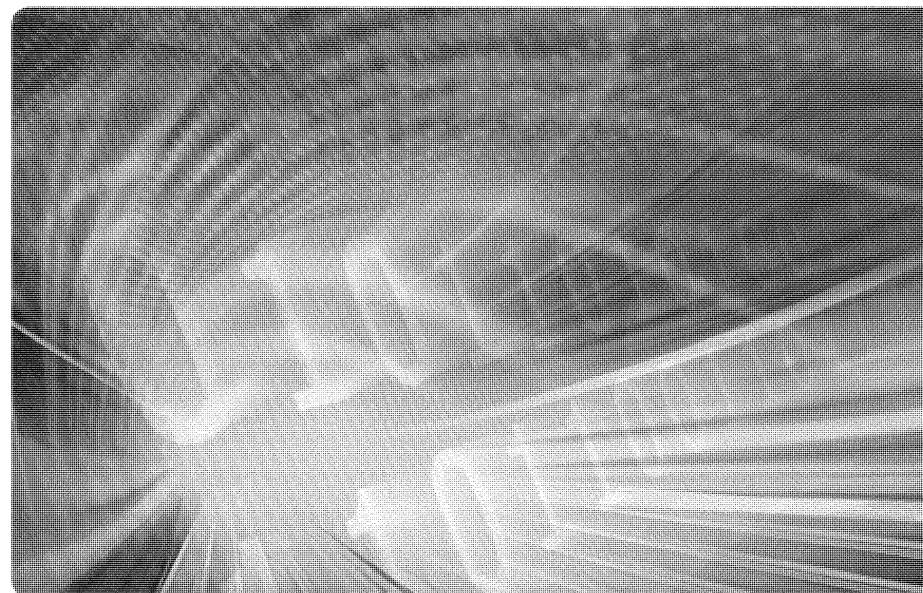
- † Delivers the highest IOPS/watt to improve system performance and reduce power and cooling costs for data center and cloud applications
- † Fast, consistent performance and low latency over the warranty period of the drive
- † Helps reduce performance gaps between storage I/O and CPU operations

Best-Fit Applications

- † Data center applications (fast data indexing, edge caching)
- † Data streaming
- † Content delivery networks
- † Gaming and software delivery
- † Virtualization and other cloud applications



CAPACITY ¹	MODEL	INTERFACE	NAND FLASH TYPE
480GB	ST480FP0021	SATA 6Gb/s	MLC
400GB	ST400FP0021	SATA 6Gb/s	MLC
240GB	ST240FP0021	SATA 6Gb/s	MLC
200GB	ST200FP0021	SATA 6Gb/s	MLC
120GB	ST120FP0021	SATA 6Gb/s	MLC
100GB	ST100FP0021	SATA 6Gb/s	MLC



¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.

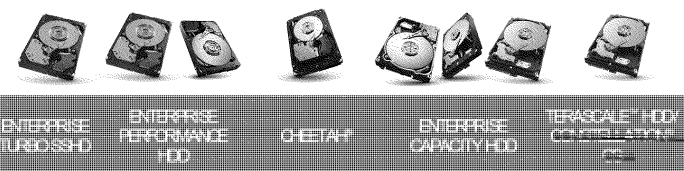
² Self-Encrypting Drives (SED) and FIPS 140-2 Validated drives are not available in all models or countries.

³ May require TCG-compliant host or controller support.

⁴ FIPS 140-2 in review. See FIPS 140-2 Level 2 Cert table at <http://csrc.nist.gov/groups/STM/comprod/validation.html>

Enterprise Storage Solutions

With more than 30 years of experience and the broadest storage product portfolio available, Seagate consistently designs, builds and supports industry-leading enterprise hard drives, solid state drives and hybrid drives. Seagate has the global presence, processes and resources to support businesses of all sizes with the highest-quality enterprise storage products.



Product Comparison	Legacy Name		Savio®		Constellation		
	Application	Highest SFF Performance	SFF Performance and Mainstream	LFF Performance	High Capacity and Low Power		Affordable High Capacity With Low Power
	Description	World's fastest hard drive	Highest-performing, highly reliable 15K- and 10K-RPM enterprise hard drives in a 2.5-inch form factor	High-performance, legacy 15K-RPM enterprise hard drive in a 3.5-inch form factor	High-capacity, low-power, reliable 7200-RPM enterprise hard drive in both 2.5- and 3.5-inch form factors		High-capacity, eco-friendly, cost-effective storage for Web-scale data centers
	Form Factor	2.5-inch	2.5-inch	3.5-inch	2.5-inch and 3.5-inch		3.5-inch
	Reliability	0.44% AFR	0.44% AFR	0.55% AFR	0.62% and 1.095% AFR		800,000 MTBF
	Capacity¹	300GB to 900GB	300GB to 1200GB	300GB to 600GB	260GB to 4TB		1TB to 4TB
	Power (Idle)	4.82W to 5.3W	4.4W to 5.3W	8.74W to 11.68W	2.52W to 7.2W		up to 4.59W
	Format	5x8E, 4K-N	512N, 5x8E, 4K-N	512N	512N, 5x8E		512E
	Interface	6Gb/s SAS	6Gb/s SAS, 4Gb/s FC	6Gb/s SAS, 4Gb/s FC	6Gb/s SAS, SATA 6Gb/s		SATA 6Gb/s
	Limited Warranty⁴	5 years	5 years	5 years	5 years		3 years

Feature Comparison	Product	Enterprise Turbo SSHD	Enterprise Performance 15K-HDD	Enterprise Performance 10K-HDD	Cheetah 15K	Enterprise Capacity 3.5 HDD	Enterprise Capacity 2.5-HDD	Terascale HDD/ Constellation CS
	Vibration Tolerance for Multi-Drive Stabilization	X	X	X	X	X	X	X
	PowerChoice™ Optimized Idle Power Settings	X	X	X		X	X	X
	Self-Encrypting Drive (SED)²	X	X	X	X	X	X	
	FIPS 140-2 SED Option²,³	X	X	X	X	X	X	
	Instant Secure Erase	X	X	X		X	X	X
	Solid State Hybrid	X						
	Energy-Saving Features	X	X	X		X	X	X
	RoHS Compliance	X	X	X	X	X	X	X

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.
² Self-Encrypting Drive models may require TCG-compliant host or controller support.
³ Some FIPS in review. See FIPS 140-2 Level 2 Certs at <http://csrc.nist.gov/groups/STM/comprod/documents/f140-1/1401vend.htm>.
⁴ Warranty terms may vary based on usage. Consult your Seagate sales representative for warranty terms and conditions.

Enterprise Turbo SSHD

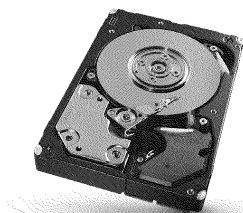
The Enterprise Turbo SSHD accelerates access to your most critical data with the world's fastest hard drive.

Key Advantages

- † Hard drive capacities with flash-based performance
- † Best economic combination of performance, endurance and capacity—best \$/OPS enterprise HDD
- † Meets critical demands for performance, scalability, flexibility and high density in a 2.5-inch form factor
- † Automatically caches hot data to flash and absorbs write intensity by only promoting hot data
- † Nonvolatile cache to enable faster write response time and help ensure data integrity during power loss

Best-Fit Applications

- † Big data analytics
- † Databases (ERP and OLTP)
- † Virtual desktop infrastructure (VDI)
- † Web development and Web page delivery



CAPACITY ¹	5xX EMULATION MODEL	INTERFACE	CACHE
600GB	ST600MX0004	6Gb/s SAS	128MB
600GB	ST600MX0014 ²	6Gb/s SAS	128MB
600GB	ST600MX0024 ³	6Gb/s SAS	128MB
450GB	ST450MX0004	6Gb/s SAS	128MB
450GB	ST450MX0014 ²	6Gb/s SAS	128MB
300GB	ST300MX0004	6Gb/s SAS	128MB
300GB	ST300MX0014 ²	6Gb/s SAS	128MB

CAPACITY ¹	4Kx NATIVE MODEL	INTERFACE	CACHE
600GB	ST600MX0034	6Gb/s SAS	128MB
600GB	ST600MX0044 ²	6Gb/s SAS	128MB
600GB	ST600MX0054 ³	6Gb/s SAS	128MB
450GB	ST450MX0034	6Gb/s SAS	128MB
450GB	ST450MX0044 ²	6Gb/s SAS	128MB
300GB	ST300MX0034	6Gb/s SAS	128MB
300GB	ST300MX0044 ²	6Gb/s SAS	128MB

Enterprise Performance 15K HDD

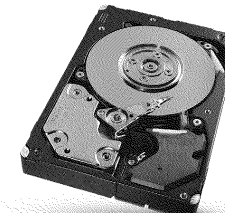
Seagate Enterprise Performance 15K HDDs leverage a 2.5-inch form factor to deliver pronounced performance advantages and power savings over legacy 3.5-inch drives.

Key Advantages

- † Stores 2" the Tier 1 data over previous generation without increasing drive count
- † Enables Tier 1 applications to process transactions more quickly
- † Best-in-class idle power for more efficient storage operations
- † Industry's highest MTBF at 2M hours
- † Self-Encrypting Drive (SED)² and FIPS SED⁴ options cut IT drive retirement costs and help protect data at rest.

Best-Fit Applications

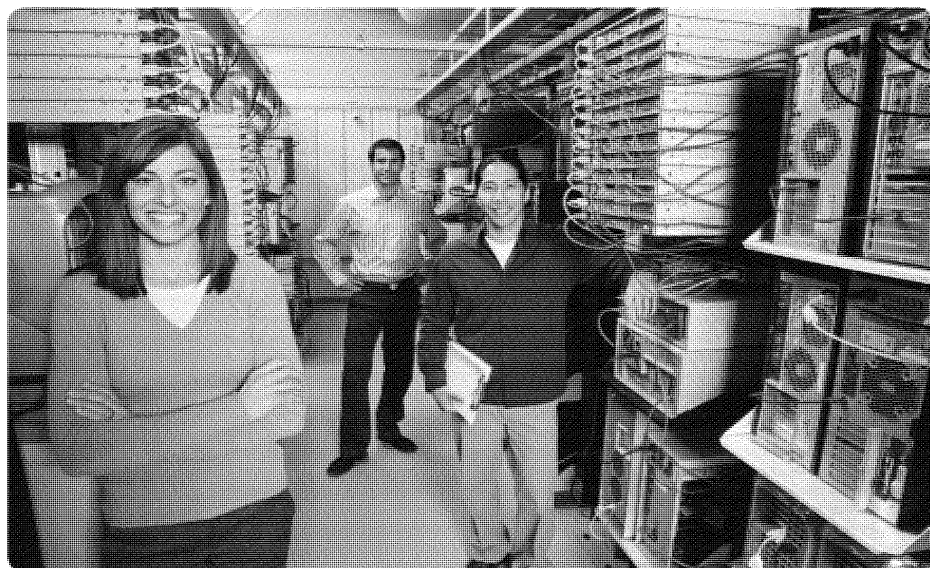
- † High-performance Tier 1 enterprise servers
- † Blade, rack and tower servers hosting transaction-based applications
- † Power- and space-constrained data centers
- † Compliance and data security initiatives



CAPACITY	5xX NATIVE MODEL	INTERFACE	CACHE
450GB	ST450MP0004	6Gb/s SAS	128MB
450GB	ST450MP0014 ²	6Gb/s SAS	128MB
300GB	ST300MP0004	6Gb/s SAS	128MB
300GB	ST300MP0014 ²	6Gb/s SAS	128MB

CAPACITY	5xX EMULATION MODEL	INTERFACE	CACHE
600GB	ST600MP0034	6Gb/s SAS	128MB
600GB	ST600MP0044 ²	6Gb/s SAS	128MB
600GB	ST600MP0054 ^{3,4}	6Gb/s SAS	128MB
450GB	ST450MP0034	6Gb/s SAS	128MB
450GB	ST450MP0044 ²	6Gb/s SAS	128MB
300GB	ST300MP0034	6Gb/s SAS	128MB
300GB	ST300MP0044 ²	6Gb/s SAS	128MB

CAPACITY	4Kx NATIVE MODEL	INTERFACE	CACHE
600GB	ST600MP0064	6Gb/s SAS	128MB
600GB	ST600MP0074 ²	6Gb/s SAS	128MB
600GB	ST600MP0084 ^{3,4}	6Gb/s SAS	128MB
450GB	ST450MP0064	6Gb/s SAS	128MB
450GB	ST450MP0074 ²	6Gb/s SAS	128MB
300GB	ST300MP0064	6Gb/s SAS	128MB
300GB	ST300MP0074 ²	6Gb/s SAS	128MB



¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.
² Self-Encrypting Drives (SED) and FIPS 140-2 Validated drives are not available in all models or countries. May require TCG-compliant host or controller support.
³ FIPS 140-2 in review. See FIPS 140-2 Level 2 Certi® date at <http://csrc.nist.gov/groups/STM/compro/documents/140-1/1401val2011.htm#1635>.
⁴ FIPS 140-2 in review. See FIPS 140-2 Level 2 Certi® date at <http://csrc.nist.gov/groups/STM/compro/validation.htm#1635>.

Enterprise Performance 10K HDD

Seagate Enterprise Performance 10K HDDs deliver the optimal balance of capacity, performance and power in a 10K-RPM, 2.5-inch enterprise drive.

Key Advantages

- † Highest-capacity enterprise SFF hard drive (up to 1.2TB)
- † PowerChoice™ technology reduces power consumption.
- † Protection Information (PI) detects corruption of data in flight between the host system and the drive⁴
- † Self-Encrypting Drive (SED)² and FIPS 140-2 certified SED³ cut IT drive retirement costs and protect data at rest. FIPS options meet government encryption compliance standards.

Best-Fit Applications

- † Mission-critical servers and external storage arrays
- † Power- and space-constrained data centers
- † Compliance or data security initiatives



CAPACITY ¹	5xx NATIVE MODEL	INTERFACE	CACHE
1200GB	ST1200MM0017 ²	6Gb/s SAS	64MB
1200GB	ST1200MM0027 ^{2,3}	6Gb/s SAS	64MB
900GB	ST900MM0026 ²	6Gb/s SAS	64MB
900GB	ST900MM0036 ^{2,3}	6Gb/s SAS	64MB
900GB	ST9900805SS	6Gb/s SAS	64MB
900GB	ST9900705SS ²	6Gb/s SAS	64MB
900GB	ST9900605SS ^{2,3}	6Gb/s SAS	64MB
900GB	ST9900805FC	4Gb/s FC	64MB
600GB	ST600MM0026 ²	6Gb/s SAS	64MB
600GB	ST9600205SS	6Gb/s SAS	64MB
600GB	ST9600105SS ²	6Gb/s SAS	64MB
600GB	ST9600005SS ^{2,3}	6Gb/s SAS	64MB
600GB	ST9600205FC	4Gb/s FC	64MB
450GB	ST450MM0026 ²	6Gb/s SAS	64MB
450GB	ST9450405SS	6Gb/s SAS	64MB
450GB	ST9450305SS ²	6Gb/s SAS	64MB
450GB	ST9450205SS ^{2,3}	6Gb/s SAS	64MB
450GB	ST9450405FC	4Gb/s FC	64MB
300GB	ST300MM0026 ²	6Gb/s SAS	64MB
300GB	ST9300605SS	6Gb/s SAS	64MB
300GB	ST9300505SS ²	6Gb/s SAS	64MB
300GB	ST9300405SS ^{2,3}	6Gb/s SAS	64MB
300GB	ST9300605FC	4Gb/s FC	64MB

Cheetah® 15K

The Seagate Cheetah 15K drive provides high performance and reliability in legacy 3.5-inch mission-critical storage.

Key Advantages

- † Sustained data rate of up to 204MB/s
- † Industry's highest 3.5-inch drive reliability
- † PowerTrim™ technology optimizes power consumption
- † Self-Encrypting Drive (SED)² and FIPS 140-2 certified SED³ cut IT drive retirement costs and protect data. FIPS options meet government encryption compliance standards.

Best-Fit Applications

- † Business and transaction processing
- † Email and decision support
- † Storage Area Networks (SAN)
- † Network Attached Storage (NAS)
- † Internet and e-commerce



CAPACITY ¹	5xx NATIVE MODEL	INTERFACE	CACHE
600GB	ST3600057SS	6Gb/s SAS	16MB
600GB	ST3600057SS ²	6Gb/s SAS	16MB
600GB	ST3600057SS ^{2,3}	6Gb/s SAS	16MB
600GB	ST3600057FC	4Gb/s FC	16MB
450GB	ST3450857SS	6Gb/s SAS	16MB
450GB	ST3450757SS ²	6Gb/s SAS	16MB
450GB	ST3450657SS ^{2,3}	6Gb/s SAS	16MB
450GB	ST3450857FC	4Gb/s FC	16MB
300GB	ST3300657SS	6Gb/s SAS	16MB
300GB	ST3300557SS ²	6Gb/s SAS	16MB
300GB	ST3300457SS ^{2,3}	6Gb/s SAS	16MB
300GB	ST3300657FC	4Gb/s FC	16MB

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.

² Self-Encrypting Drives (SED) and FIPS 140-2 Validated drives are not available in all models or countries.

³ May require TOG-compliant host or controller support.

⁴ FIPS 140-2 in review. See FIPS 140-2 Certified data at <http://csrc.nist.gov/groups/STM/cmvp/documents/140-1/140val2011.htm#1635>

⁵ Protection Information (PI) feature requires PI-compliant host or controller support.

Enterprise Capacity 3.5 HDD

The Seagate Enterprise Capacity 3.5 HDDs help data centers meet the demanding growth of unstructured data.

Key Advantages

- † Highest-capacity enterprise drive for maximum density server and storage solutions
- † SAS and SATA interfaces with 24x7 reliability
- † Predictable 7200-RPM performance even in the most rugged multi-drive environments
- † Improved power and cooling efficiencies with low power consumption and on-demand PowerChoice™ technology
- † Protect your data and ease data disposal costs and management with the Self-Encrypting Drive (SED) and FIPS 140-2 certified SED^{2,3}

Best-Fit Applications

- † High-capacity RAID storage
- † Mainstream enterprise external storage (SAN, NAS, DAS)
- † Cloud bulk data storage
- † Enterprise backup and restore—D2D, virtual tape
- † Centralized surveillance



CAPACITY ¹	5xx NATIVE MODEL	INTERFACE	CACHE
4TB	ST4000NM0033	SATA 6Gb/s	128MB
4TB	ST4000NM0053 ²	SATA 6Gb/s	128MB
4TB	ST4000NM0073 ^{2,3}	SATA 6Gb/s	128MB
4TB	ST4000NM0023	6Gb/s SAS	128MB
4TB	ST4000NM0043 ²	6Gb/s SAS	128MB
4TB	ST4000NM0063 ^{2,3}	6Gb/s SAS	128MB
3TB	ST3000NM0033	SATA 6Gb/s	128MB
3TB	ST3000NM0053 ²	SATA 6Gb/s	128MB
3TB	ST3000NM0023	6Gb/s SAS	128MB
3TB	ST3000NM0043 ²	6Gb/s SAS	128MB
3TB	ST3000NM0063 ^{2,3}	6Gb/s SAS	128MB
2TB	ST2000NM0033	SATA 6Gb/s	128MB
2TB	ST2000NM0053 ²	SATA 6Gb/s	128MB
2TB	ST2000NM0023	6Gb/s SAS	128MB
2TB	ST2000NM0043 ²	6Gb/s SAS	128MB
2TB	ST2000NM0063 ^{2,3}	6Gb/s SAS	128MB
1TB	ST1000NM0033	SATA 6Gb/s	128MB
1TB	ST1000NM0053 ²	SATA 6Gb/s	128MB
1TB	ST1000NM0023	6Gb/s SAS	128MB
1TB	ST1000NM0043 ²	6Gb/s SAS	128MB
1TB	ST1000NM0063 ^{2,3}	6Gb/s SAS	128MB

Constellation®

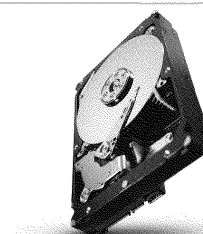
The Seagate Constellation drive is the only 2.5-inch enterprise-class hard drive delivering both 1TB capacities and enterprise reliability.

Key Advantages

- † Maximizes data center footprint
- † Energy-efficient storage at under 3.9W (idle)
- † Highest nearline reliability with an MTBF of 1.4M hours
- † Self-Encrypting Drive (SED)² and FIPS 140-2 certified SED³ cut IT drive retirement costs and protect data.
- † FIPS options meet government encryption compliance standards.

Best-Fit Applications

- † Storage-hungry business applications
- † Storage area networks and network attached storage
- † Maximum-capacity servers and blade servers
- † Rich media content storage
- † Enterprise backup and restore—D2D, virtual tape
- † Cloud computing



CAPACITY ¹	5xx NATIVE MODEL	INTERFACE	CACHE
1TB	ST91000640NS	SATA 6Gb/s	64MB
1TB	ST91000641NS ²	SATA 6Gb/s	64MB
1TB	ST91000642NS ^{2,4}	SATA 6Gb/s	64MB
1TB	ST91000640SS	6Gb/s SAS	64MB
1TB	ST91000641SS ²	6Gb/s SAS	64MB
1TB	ST91000642SS ^{2,4}	6Gb/s SAS	64MB
500GB	ST9500620NS	SATA 6Gb/s	64MB
500GB	ST9500621NS	SATA 6Gb/s	64MB
500GB	ST9500622NS²	SATA 6Gb/s	64MB
500GB	ST9500620SS	6Gb/s SAS	64MB
500GB	ST9500621SS²	6Gb/s SAS	64MB
500GB	ST9500622SS^{2,4}	6Gb/s SAS	64MB
250GB	ST9250610NS	SATA 6Gb/s	64MB
250GB	ST9250611NS	SATA 6Gb/s	64MB
250GB	ST9250612NS^{2,4}	SATA 6Gb/s	64MB

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.

² Self-Encrypting Drives (SED) and FIPS 140-2 Validated drives are not available in all models or countries. May require TCG-compliant host or controller support.

³ See FIPS 140-2 Level 2 Certi. date at <http://seagate.com/groupse/STW/comp/documents/140-1/1401vend.htm>.

⁴ FIPS 140-2 in review. See FIPS 140-2 Level 2 Certi. date at <http://seagate.com/groupse/STW/comp/documents/140-1/1401val2011.htm#1635>.

Terascale™ HDD Constellation® CS

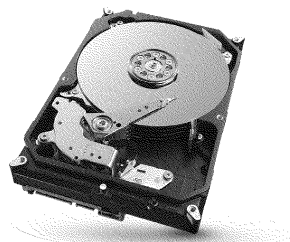
The Seagate Terascale HDD and Constellation CS are designed for large Web-scale data centers where low-cost, low-power and high-capacity storage is critical.

Key Advantages

- † Affordable storage for 24"7 multi-drive replicated environments
- † High vibration tolerance for reliable enterprise-class performance
- † Low power and cooling costs with the lowest 3.5-inch enterprise drive operating power
- † Advanced format logical block management for industry-leading data integrity

Best-Fit Applications

- † Web-scale computing
- † Cloud storage servers and arrays
- † Cloud backup storage
- † Direct-attached external storage (DAS)
- † Network-attached storage (NAS)

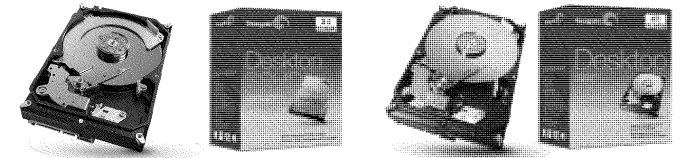


CAPACITY	5xx EMULATION MODEL	INTERFACE	CACHE
4TB	ST4000NC000 ¹	SATA 6Gb/s	64MB
4TB	ST4000NC001	SATA 6Gb/s	64MB
3TB	ST3000NC002	SATA 6Gb/s	64MB
3TB	ST3000NC000 ¹	SATA 6Gb/s	64MB
2TB	ST2000NC001	SATA 6Gb/s	64MB
2TB	ST2000NC000 ¹	SATA 6Gb/s	64MB
1TB	ST1000NC001	SATA 6Gb/s	64MB
1TB	ST1000NC000 ¹	SATA 6Gb/s	64MB



Desktop Storage Solutions

Seagate has a distinguished history in consistently delivering innovative technologies, super-sized capacities, low power and blazing-fast performance. Seagate desktop drives offer excellent performance at all levels.



	DESKTOP SSD	DESKTOP SHDD INTERNAL KIT	DESKTOP HDD	DESKTOP 3.5 INCH INTERNAL KIT
Legacy Name			Barracuda®	Barracuda
Application	Performance	Performance	Mainstream	Mainstream
Description	Solid state hybrid drive delivers SSD-like performance without sacrificing capacity	The easy way to upgrade or add storage capacity to desktop computers to get solid state speed for fast, responsive system performance	Tuned performance for low-power, mainstream and high-performance desktop computing	The fast, powerful and easy way to upgrade or add storage capacity to desktop computers
Capacity ¹	1TB to 4TB	1TB to 4TB	250GB to 4TB	500GB to 4TB
Interface	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s	SATA 3Gb/s, SATA 6Gb/s
Form Factor	3.5 inch	3.5 inch	3.5 inch	3.5 inch
Reliability	<1% AFR	<1% AFR	<1% AFR	<1% AFR
Cache	64MB	64MB	16MB to 64MB	16MB to 64MB
Power (Idle)	<3.3W to <3.9W	<3.3W to <3.9W	4.0W to 5.8W	
Product	Desktop SSD	Desktop SHDD Internal Kit	Desktop HDD	Desktop 3.5 inch Internal Kit
OptiCache™ Technology			X	X
Solid State Hybrid	X	X		
Mounting Hardware and Cables		X		X
Compatible with Windows 8 ²	X	X	X	X
Energy-Saving Features	X	X	X	X
RoHS Compliance	X	X	X	X

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.
² For a complete list of Seagate products that are compatible with Windows 8, visit <http://www.microsoft.com/en-us/windows/compatibility/win8/CompatCenter/home>

Desktop SSHD

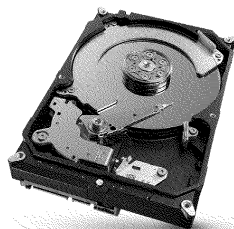
Seagate Desktop SSHD (solid state hybrid drive) delivers SSD-like performance and massive capacities at an affordable price.

Key Advantages

- † First SSHD in a 3.5-inch form factor
- † SATA 6Gb/s with NCQ for interface speed
- † Up to 3× faster than a traditional HDD²
- † All-in-one design for ease of installation
- † Installs and operates like a standard hard drive
- † Massive 1TB or 2TB capacities combined with SSD-like performance²

Best-Fit Applications

- † Desktop PCs
- † Workstations
- † High-performance direct-attached storage (DAS) devices



CAPACITY ¹	MODEL	INTERFACE	CACHE
4TB	ST2000DX001	SATA 6Gb/s	64MB
2TB	ST2000DX001	SATA 6Gb/s	64MB
1TB	ST1000DX001	SATA 6Gb/s	64MB

Desktop 3.5-Inch Internal Kit

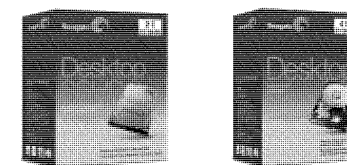
Seagate 3.5-inch internal drives are the fast, powerful, and easy way to upgrade or add storage capacity to desktop computers.

Key Advantages

- † Quiet, ultra-high performance
- † DiscWizard™ software makes installation a snap
- † Built-in self-monitoring technology helps ensure maximum reliability
- † Desktop solid state hybrid model offers SSD-like performance with the capacity of a hard drive

Best-Fit Applications

- † Gaming PCs
- † Workstations
- † High-end PCs
- † Desktop RAID
- † Mainstream/office PCs



CAPACITY ¹	KIT NUMBER ³	INTERFACE	CACHE
4TB	STBD4000400	SATA 6Gb/s	64MB
3TB	STBD3000100	SATA 6Gb/s	64MB
2TB	STBD2000101	SATA 6Gb/s	64MB
1TB	ST310005N1A1AS-RK	SATA 6Gb/s	64MB
500GB	ST3500641AS-RK	SATA 3Gb/s	64MB
PACKAGE DIMENSIONS	7.38-in L x 5.88-in W x 2.88-in D (187mm x 149mm x 73mm)		

DESKTOP SSHD MODEL			
CAPACITY	KIT NUMBER ³	INTERFACE	MLC FLASH
2TB	STCL2000400	SATA 6Gb/s	8GB
PACKAGE DIMENSIONS	5.88-in L x 7.38-in W x 2.88-in D (149.35mm x 187.45mm x 73.15mm)		

Desktop HDD

Seagate Desktop HDDs give you the Power of One with 1TB-per-disk technology and one drive platform for every capacity and application.

Key Advantages

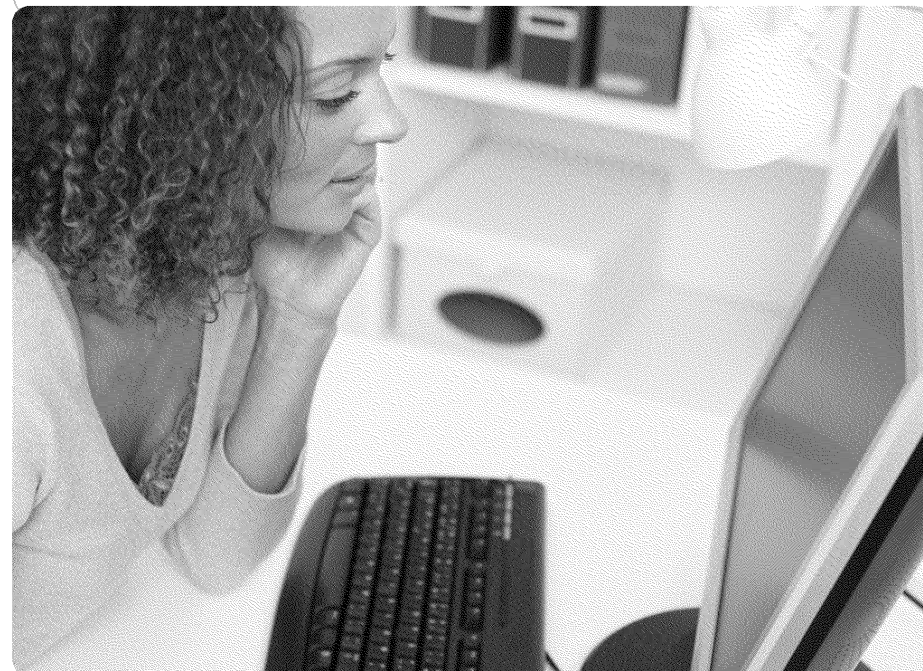
- † Up to 4TB capacity
- † AcuTrac™ and OptiCache™ technologies deliver dependable overall performance.
- † Free Seagate DiscWizard™ software

Best-Fit Applications

- † Desktop or all-in-one PCs and home servers
- † PC-based gaming systems
- † Direct-attached external storage devices (DAS)

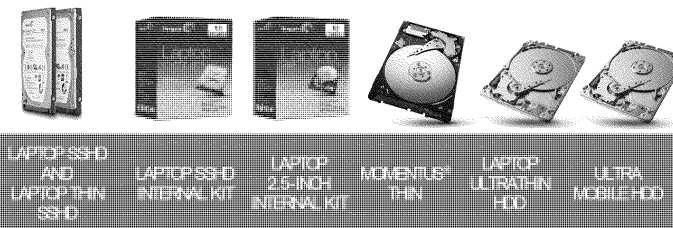


CAPACITY ¹	MODEL	INTERFACE	CACHE
4TB	ST4000DM000	SATA 6Gb/s NCQ	64MB
3TB	ST3000DM001	SATA 6Gb/s NCQ	64MB
2TB	ST2000DM001	SATA 6Gb/s NCQ	64MB
1TB	ST1000DM003	SATA 6Gb/s NCQ	64MB
500GB	ST500DM002	SATA 6Gb/s NCQ	16MB
320GB	ST320DM000	SATA 6Gb/s NCQ	16MB
250GB	ST250DM000	SATA 6Gb/s NCQ	16MB



Mobile Storage Solutions

Seagate laptop and tablet drives address every mobile market need, delivering superior performance, reliability and value. Feature-rich with innovative options, the Seagate mobile lineup also includes self-encryption and FIPS 140-2 validated models.



Product Comparison	Legacy Name	Momentus XT	Momentus XT	Momentus Internal Kit			
	Application	Performance	Performance	Performance	Mainstream, Slim Computing	Slim Computing	Slim, Robust Computing
	Description	Solid state hybrid drives deliver SSD-like performance without sacrificing capacity	The easy way to upgrade or add storage capacity to laptop computers to get solid state speed with capacity of a hard disk drive	A complete upgrade kit to transform your system to high performance or just add capacity	The 2.5-inch drive for laptops and notebooks	Affordable, high-capacity storage that is thinner than a pencil	Brings robust storage ideal for ultra-slim tablet, convertible and detachable applications in a 5mm form factor
	Capacity ¹	500GB and 1TB	500GB and 1TB	250GB and 1TB	250GB, 320GB and 500GB	320GB and 500GB	500GB
	Interface	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s
	Form Factor/ z-Height	2.5-inch/ 9.5mm, 7mm	2.5-inch/ 9.5mm, 7mm	2.5-inch/9.5mm	2.5-inch/7mm	2.5-inch/5mm	2.5-inch/5mm
	Reliability	0.48% AFR	0.48% AFR	0.48% AFR	0.48% AFR		
	Cache	64MB	64MB	16MB	16MB	16MB	16MB
	Power (Idle)	0.9W	0.9W	0.67W to 0.81W	0.49W	0.48W	0.48W
	Product	Laptop SSD and Laptop Thin SSD	Laptop SSD Internal Kit	Laptop 2.5-inch Internal Kit	Momentus [®] Thin	Laptop Ultrathin HDD	Ultra Mobile HDD
Feature Comparison	Self-Encrypting Drive (SED) with Instant Secure Erase ²				X	X	
	FIPS 140-2 SED Option ^{2,3}				X		
	Drop Sensor Options						X
	Solid State Hybrid	X	X				
	Compatible with Windows 8 ⁴	X	X	X	X	X	X
	Energy-Saving Features	X	X		X	X	X
	RoHS Compliance	X	X	X	X	X	X

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.

² Self-Encrypting Drive models may require TCG-compliant host or controller support.

³ Some FIPS in review. See FIPS 140-2 Level 2 Certified at <http://csrc.nist.gov/groups/STM/compro/documents/140-1/1402t1end.htm>.

⁴ For a complete list of Seagate products that are compatible with Windows 8, visit <http://www.microsoft.com/en-us/windows/compatibility/windows8/compatibility.htm>.

Laptop SSHD and Laptop Thin SSHD

The Seagate Laptop SSHD (1TB) and Laptop Thin SSHD (500GB) enable laptop PC users to enjoy solid state performance without sacrificing capacity.



Key Advantages

- † Boots and performs like an SSD¹
- † Up to 4x faster than a traditional HDD²
- † SATA 6Gb/s with NCQ for interface speed
- † All-in-one design for simplicity and ease of installation
- † Works in any laptop or PC, any OS and any application
- † Backed by a 3-year limited warranty

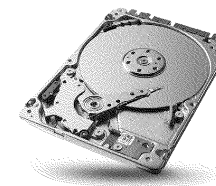
Best-Fit Applications

- † Laptops and mobile workstations
- † Desktop and tower workstations
- † High-performance laptop and desktop gaming systems
- † Small form factor all-in-one PCs

CAPACITY ¹	MODEL	INTERFACE	CACHE
1TB	ST1000LM014	SATA 6Gb/s	64MB
500GB	ST500LM000	SATA 3Gb/s	64MB

Laptop Ultrathin HDD

The Seagate Laptop Ultrathin HDD is one of the thinnest and lightest laptop hard drives—5mm, 3.3 oz. and thinner than a pencil.



Key Advantages

- † Affordable, high-capacity storage gives system builder options when integrating low profile storage into slim laptop and ultrabook solutions
- † Compatible with every portable PC with a standard SATA 6Gb/s interface
- † Get industry-leading cost-per-GB and cost-per-millimeter
- † Seagate Secure™ Self-Encrypting Drive options³

Best-Fit Applications

- † Slim laptops or ultrabooks
- † Extending high-capacity, affordable storage into other applications and slim devices
- † Backup storage

CAPACITY ¹	MODEL	INTERFACE	CACHE
500GB	ST500LT032	SATA 6Gb/s	16MB
500GB	ST500LT033 ⁴	SATA 6Gb/s	16MB
320GB	ST320LT030	SATA 6Gb/s	16MB

Momentus® Thin

The 7mm, 2.5-inch drive enables slim computing for all types of mobile computing, from laptops to netbooks to smaller desktop PCs.



Key Advantages

- † 7mm z-height form factor enables thin chassis design for all segments of laptop computing.
- † Seagate SmartAlign™ technology provides a transition to 4K sectors without the need for software utilities.
- † Self-Encrypting Drive³ options mitigate data breaches, comply with data protection regulations and preserve brand recognition.
- † Self-Encrypting Drive options with FIPS 140-2 certification⁴ are government-approved for the U.S. and Canadian governments.

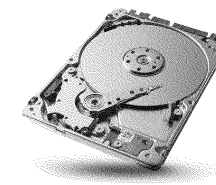
Best-Fit Applications

- † Thin entry-level laptop PCs
- † Thin high-end netbooks
- † Thin ultraportables

CAPACITY ¹	MODEL	INTERFACE	CACHE
500GB	ST500LT025 ⁵	SATA 6Gb/s	16MB
500GB	ST500LT015 ⁵	SATA 6Gb/s	16MB
500GB	ST500LT012	SATA 6Gb/s	16MB
320GB	ST320LT012	SATA 6Gb/s	16MB
250GB	ST250LT012	SATA 6Gb/s	16MB

Ultra Mobile HDD

Just 5mm thin and supported by a stainless steel design, the Seagate Ultra Mobile HDD is ready for mobility.



Key Advantages

- † 500GB brings 7" more space to tablet applications at a fraction of the cost.
- † Zero-gravity sensors provide extra drop protection.
- † Improved shock and tolerance for gyroscopic motion supports even the intense maneuvers of gamers.
- † Just 3.3 oz.—about the weight of a lightbulb
- † Couple with the Seagate Mobile Enablement Kit's Dynamic Data™ Driver for robust and responsive storage with no compromise to system battery life.

Best-Fit Applications

- † Tablets
- † Convertible and detachable storage
- † Ultra-mobile, ultra-portable storage expansion apps

CAPACITY ¹	MODEL	INTERFACE	CACHE
500GB	ST500LT035	SATA 6Gb/s	16MB

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.
² Performance may vary depending on user's hardware configuration and operating system. Testing performed on a Laptop SSHD 1TB and a Laptop Thin SSHD 500GB.
³ Self-Encrypting Drives (SED) are not available in all models or countries. May require TCG-compliant host or controller support.
⁴ See FIPS 140-2 Level 2 Certi-icate at <http://seagate.com/groups/STN/omvp/documents/140-1/1401vend.htm>.
⁵ SmartAlign technology is not available on this model.

Laptop 2.5-Inch Internal Kit

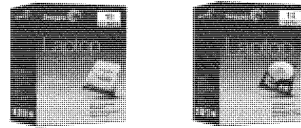
Seagate 2.5-inch internal drives deliver vast amounts of storage for adding capacity or upgrading drives in laptop computers.

Key Advantages

- † Built for mobility
- † Preserves battery life
- † Large data cache
- † Outstanding performance
- † Laptop solid state hybrid model offers SSD-like performance with the capacity of a hard drive.

Best-Fit Applications

- † Replacement laptop drives
- † Laptop storage upgrades
- † High-end laptops and workstations



CAPACITY ¹	KIT NUMBER ²	INTERFACE	CACHE
1TB	STBD1000100	SATA 3Gb/s	8MB
500GB	ST905003N3A1AS-RK	SATA 3Gb/s	16MB
500GB	ST905003N1A1AS-RK	SATA 3Gb/s	8MB
250GB	ST90250N1A1AS-RK	SATA 3Gb/s	8MB
PACKAGE DIMENSIONS	6.25-in L x 4.75-in W x 2.25-in D (159mm x 121mm x 57mm)		

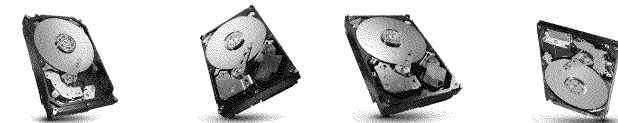
LAPTOP SSD MODEL			
CAPACITY	KIT NUMBER	INTERFACE	MLC FLASH
1TB	STBD1000400	SATA 6Gb/s	8GB
PACKAGE DIMENSIONS	6.25-in L x 4.75-in W x 2.25-in D (159mm x 121mm x 57mm)		



Specialty Storage Solutions

Storage solutions for NAS, DVRs and surveillance systems

Seagate has the expertise to build drives optimized for specialty environments, like Network Attached Storage (NAS), CE and video storage. Our global presence, business partnerships, technology leadership and industry understanding enable Seagate to deliver industry-leading products.



	NAS HDD	C25 Series™	VIDEO 3.5 HDD	VIDEO 2.5 HDD
Legacy Name			Pipeline® HD	Pipeline HD Mini
Application	Small NAS	Video Surveillance	Mainstream CE-DVR	Small form factor CE-DVR
Description	Best-performing, highest-capacity storage for 1- to 5-bay NAS systems	Optimized performance and improved reliability for video surveillance applications	Cool, quiet, low-power performance—perfect for high-definition consumer DVR applications	Cool, quiet, low power—perfect for small form factor and power-sensitive designs
Capacity ¹	2TB to 4TB	1TB to 8TB	250GB to 4TB	250GB to 500GB
Interface	SATA 6Gb/s	SATA 6Gb/s	SATA 3Gb/s, SATA 6Gb/s	SATA 3Gb/s
Form Factor	3.5-inch	3.5-inch	3.5-inch	2.5-inch
Simultaneous HD Streams Supported	—	—	up to 16	up to 12
Reliability	1M hours MTBF	<1% AFR	0.55% AFR	0.55% AFR
Cache	64MB	64MB	8MB to 64MB	16MB
Power (Idle)	3.0W to 3.95W	3.36W to 5.4W (Idle2)	2.5W to 5.0W	0.68W
Product	NAS HDD	C25 Series	Video 3.5 HDD	Video 2.5 HDD
Cool Operation		x	x	x
24x7 Operation Capable	x	x	x	x
Extremely Low Vibration	x			
NASWorks™ Technology	x			
Energy-Saving Features	x		x	x
RoHS Compliance	x	x	x	x

¹ One gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes when referring to drive capacity.

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NAS HDD

The Seagate NAS HDD fine-tunes the needs of 1- to 5-bay NAS systems to provide industry-leading performance and highest-capacity storage.

Key Advantages

- † NASWorks™ technology supports custom error recovery controls, power management and vibration tolerance.
- † NAS error recovery controls help to ensure drives are not dropped from the NAS and sent into a RAID rebuild.
- † Improved vibration tolerance and emission in multi-drive systems with dual-plane balance
- † Advanced power management supports multiple power profiles for low-power, 24*7 performance.

Best-Fit Applications

- † Home servers or desktop NAS solutions
- † Small-business file sharing
- † Backup servers



CAPACITY*	MODEL	INTERFACE	CACHE
4TB	ST4000/N000	SATA 6Gb/s	64MB
3TB	ST3000/N000	SATA 6Gb/s	64MB
2TB	ST2000/N000	SATA 6Gb/s	64MB

Video 3.5 HDD

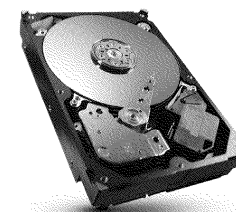
Seagate Video 3.5 HDDs deliver unprecedented levels of acoustic, power and vibration performance with room for hundreds of your favorite movies.

Key Advantages

- † Quiet drive operation to enhance customer viewing and listening experiences
- † 75°C, 24-hour operation capable
- † Operational power consumption as low as 3.4W
- † 2.0A spin-up current limited

Best-Fit Applications

- † Consumer digital video recorders
- † Media servers and centers
- † Home theater PCs and servers
- † Cable, satellite and IPTV set-top boxes



CAPACITY*	MODEL	INTERFACE	CACHE
4TB	ST4000/M000	SATA 6Gb/s	64MB
3TB	ST3000/M002	SATA 6Gb/s	64MB
2TB	ST2000/M003	SATA 6Gb/s	64MB
1TB	ST1000/M002	SATA 6Gb/s	64MB
500GB	ST3500312CS	SATA 3Gb/s	8MB
320GB	ST3320311CS	SATA 3Gb/s	8MB
250GB	ST3250312CS	SATA 3Gb/s	8MB

SV35 Series™

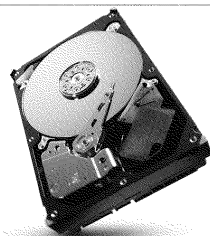
The Seagate SV35-series drives optimize performance, save power and improve reliability for video surveillance applications.

Key Advantages

- † Higher areal density for cost-effective DVR applications
- † Performance-tuned for seamless video applications
- † Enterprise-class reliability for 24x7 video surveillance applications
- † Built-in error recovery for non-stop streaming

Best-Fit Applications

- † Video surveillance digital video recorder
- † Video surveillance network digital video recorder
- † Direct-attached JBOD video surveillance storage
- † Network-attached JBOD video storage



CAPACITY*	MODEL	INTERFACE	CACHE
3TB	ST3000/X000	SATA 6Gb/s	64MB
2TB	ST2000/X000	SATA 6Gb/s	64MB
1TB	ST1000/X000	SATA 6Gb/s	64MB

Video 2.5 HDD

Seagate Video 2.5 HDDs let you stream, record and play back your video content with unparalleled reliability and performance.

Key Advantages

- † Virtually silent streaming performance as low as 19dB
- † Built for 24*7 operation and low power consumption
- † Small, 2.5-inch form factor allows system cost reduction and operational power savings
- † Fanless design allows flexibility in a sleek system design.
- † 0.55% AFR supports longevity in demanding consumer electronic environments.

Best-Fit Applications

- † DVR and media center applications
- † Home theater PCs
- † Karaoke and audio jukeboxes
- † Cable, satellite and IPTV set-top boxes
- † In-camera or surveillance systems



CAPACITY*	MODEL	INTERFACE	CACHE
500GB	ST500V/T000	SATA 3Gb/s	16MB
320GB	ST320V/T000	SATA 3Gb/s	16MB
250GB	ST250V/T000	SATA 3Gb/s	16MB

Partner Resources and Benefits

The Seagate Partner Program (SPP) provides access to unique resources and benefits to help channel partners secure new opportunities and grow revenue and profitability.

As a registered SPP member, you enjoy the following exclusive features:

- † Password-protected portal
- † E-newsletter and regular news updates
- † New product evaluation unit program
- † Training and sales tools
- † Priority support

Start reaping the rewards of SPP membership—register today at www.seagate.com/www/partners

- † Complete the online form.
- † Click through and accept our standard agreement.



Service and Support

For information regarding products and services, visit www.seagate.com/about/contact-us/technical-support

Available services include:

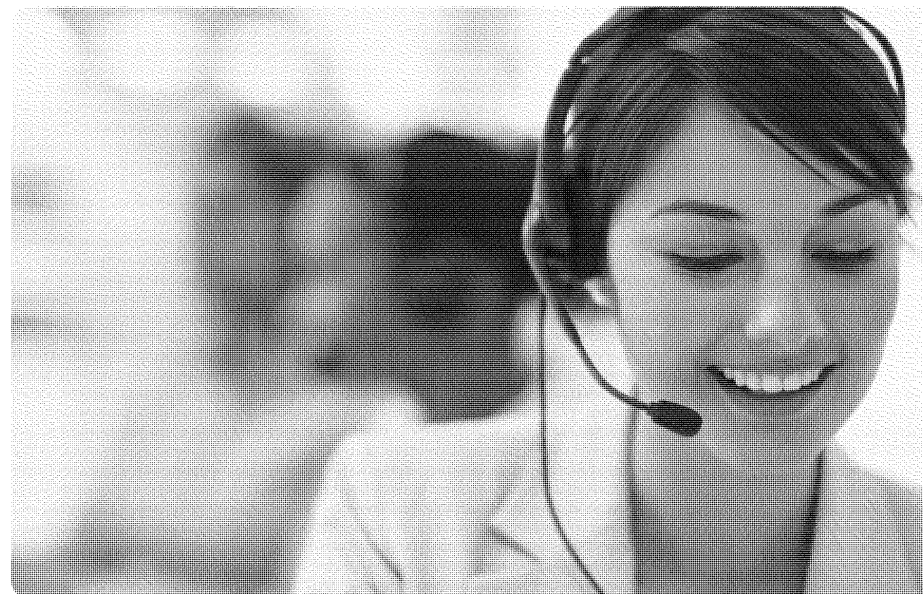
- † Presales and Technical Support
- † Global Support Services telephone numbers and business hours
- † Authorized Seagate Service Centers

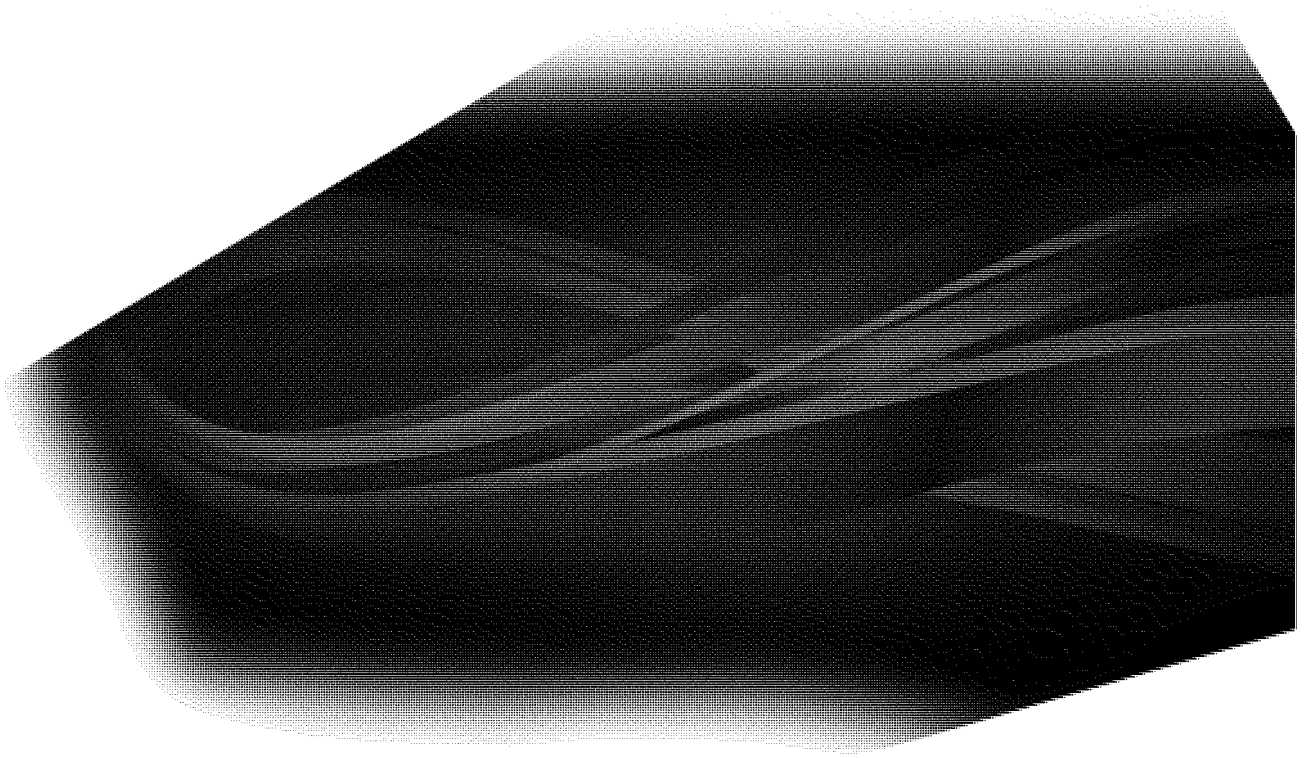
For information regarding Warranty Support, visit www.seagate.com/support/warranty-and-returns

For information regarding Data Recovery Services, visit www.seagate.com/services-software/

For Seagate OEM and Distribution partner portal, visit www.seagate.com/www/partners

For Seagate reseller portal, visit www.seagate.com/www/partners





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10200 South De Anza Boulevard
Cupertino, California 95014
408-658-1000

FED_SEAG0012340**Metadata**

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Custodian Other	Clough, Sharon	ORIGINAL
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FED_ENDATTACH	FED_SEAG0012364	ORIGINAL
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EXHIBIT 22



RHO Quality Update PSG/NSG

Robert LaBore

May 3rd 2013



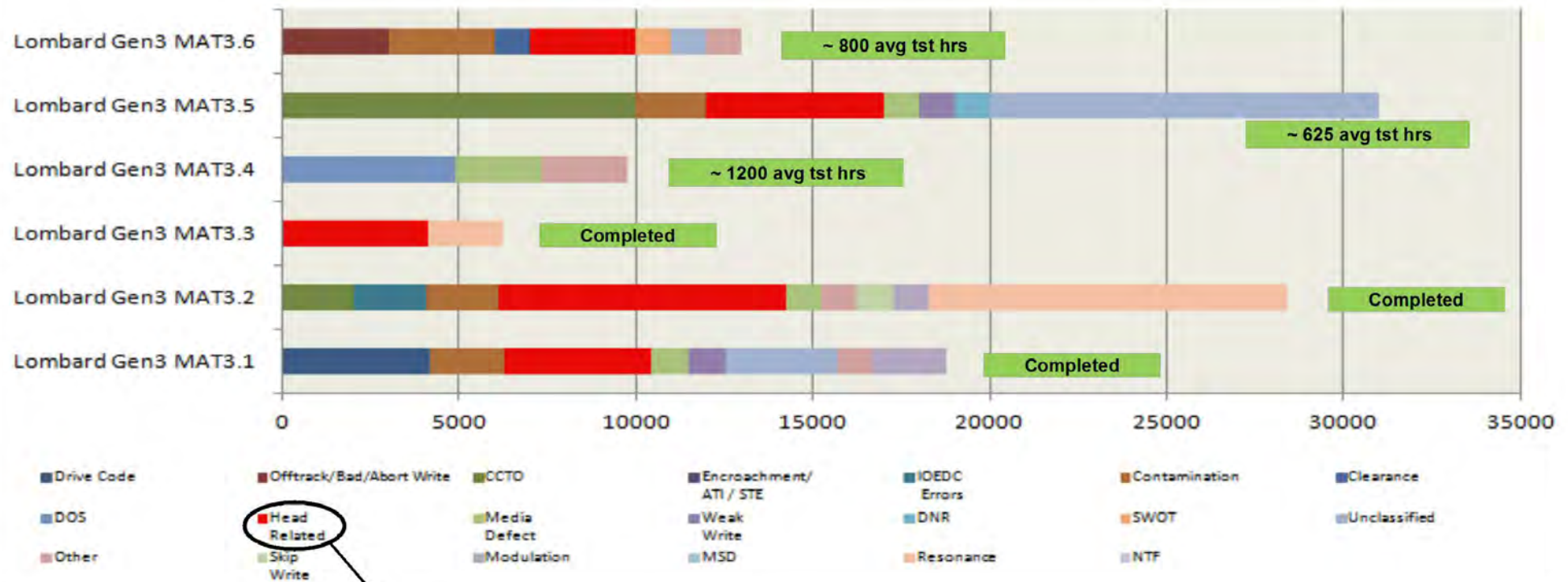


New Products (Pre SAD)

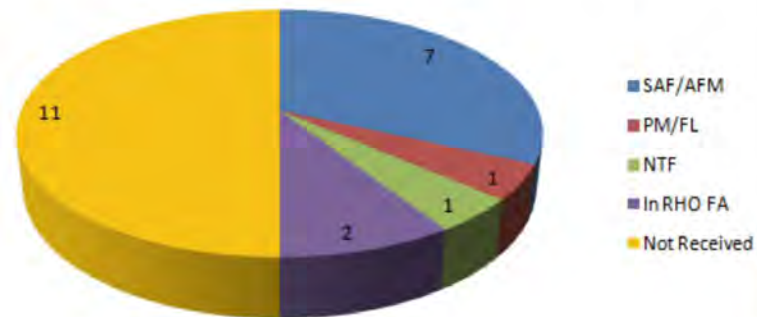


Lombard Reliability Pareto - Multiple Test Beds

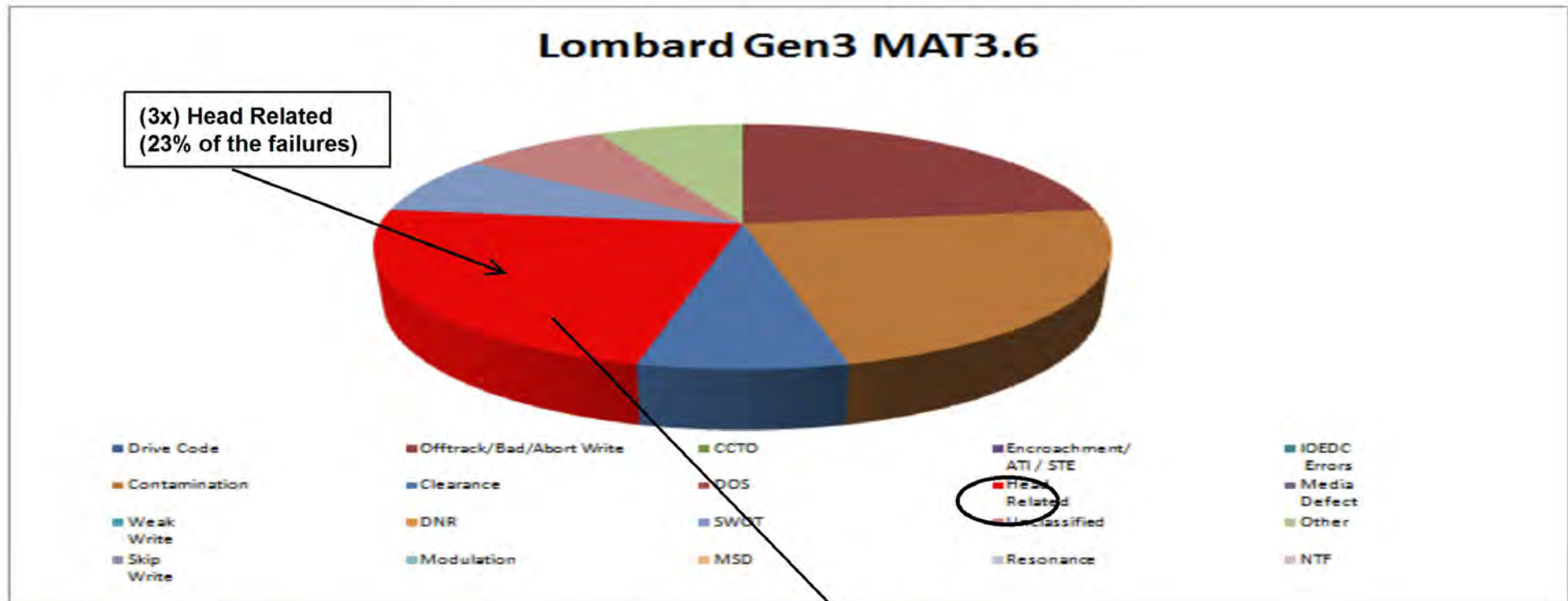
New Product Reliability Pareto - May 2013



Q313 Lombard Total (MAT's 3.1-3.6)



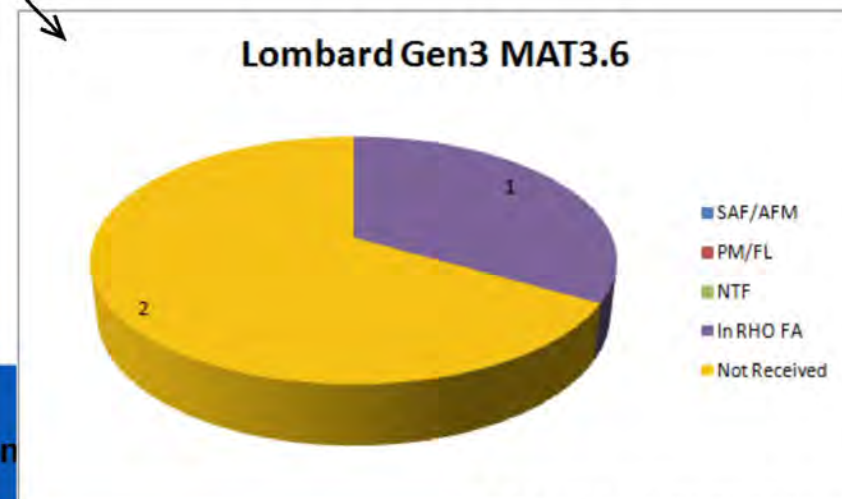
Lombard Reliability Pareto (Gen3-MAT3.6) - May



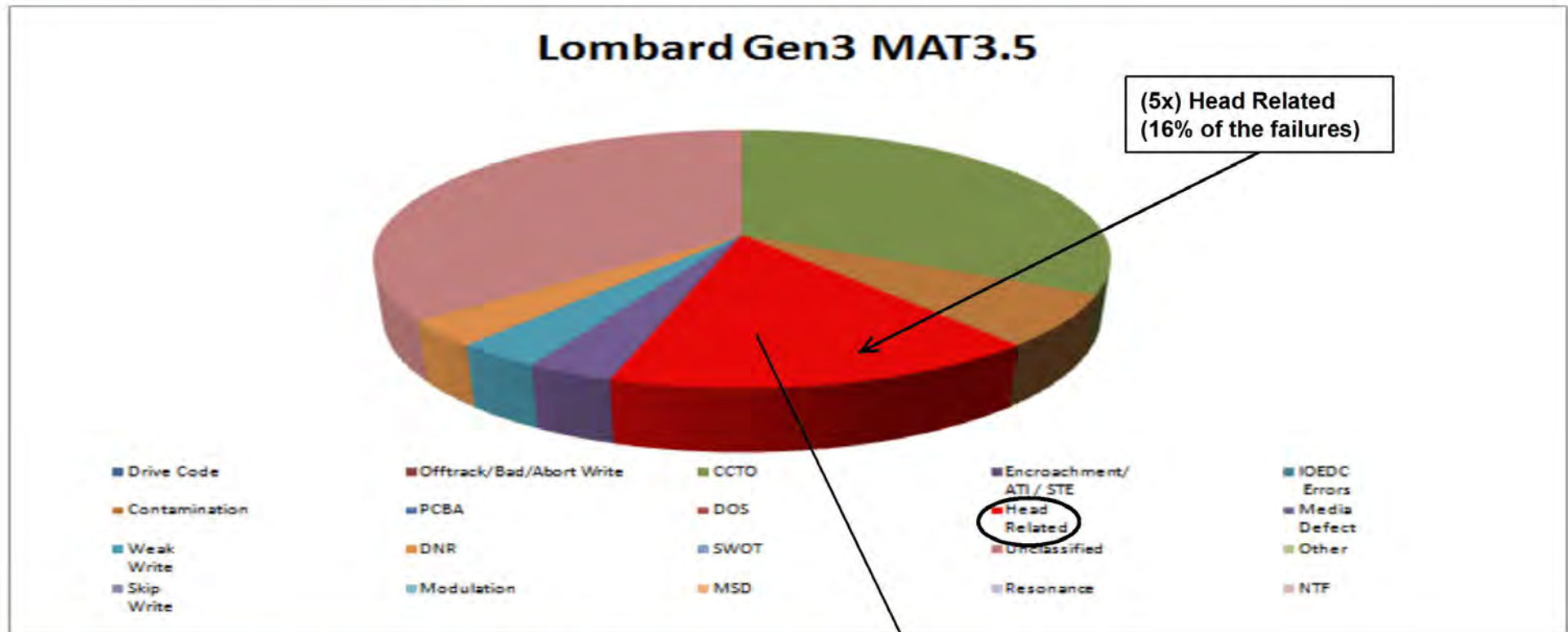
Lombard Head Related Reliability Failures – 3 failures out of 1001 Gen3 MAT3.6 drives. (13 failures total).

Actions that have or will be taken to date include

- (1x) Unstable head: Drive Z30087E0-TTF=100hrs / drive Z300873L-TTF=226hrs
drive Z300B87E-TTF=448hrs
 - Drive Z30087E0 – In RHO FA.



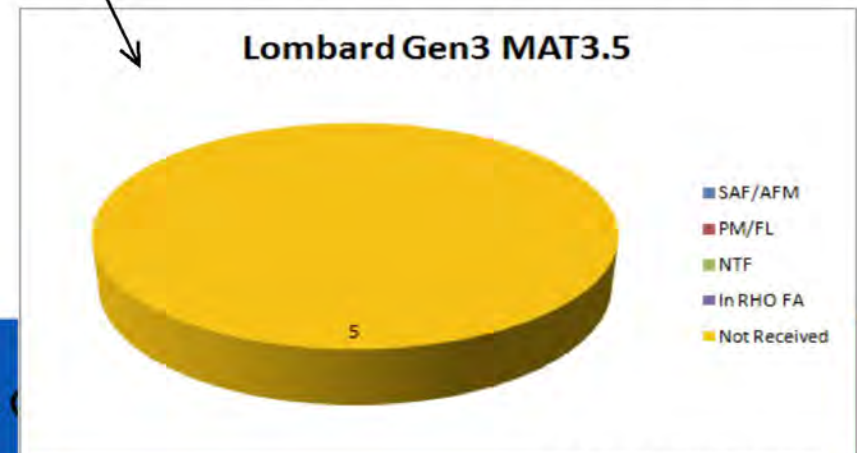
Lombard Reliability Pareto (Gen3-MAT3.5) - May



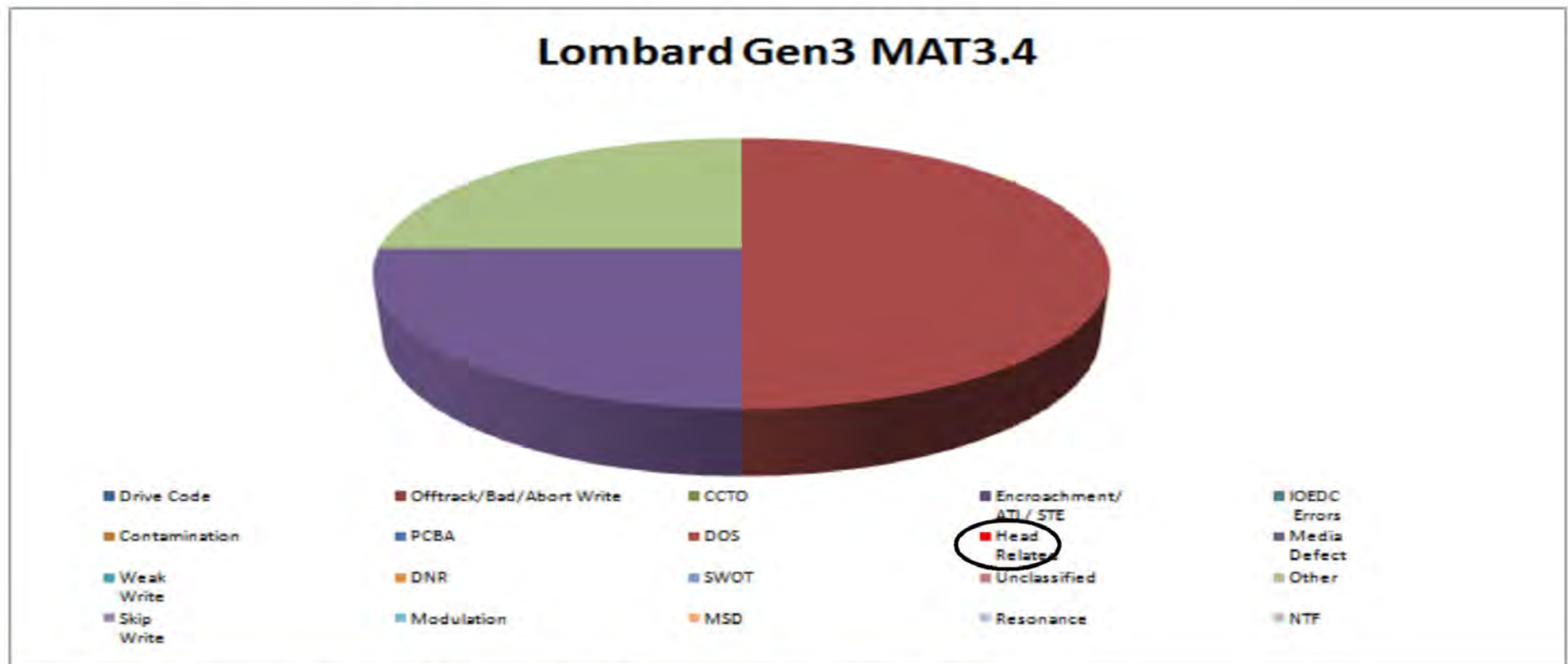
Lombard Head Related Reliability Failures – 5 failures out of 1000 Gen3 MAT3.5 drives. (31 failures total).

Actions that have or will be taken to date include

- (5x) Unstable head: Drive Z3009J5L-TTF=523hrs / drive Z3009J8Z-TTF=608hrs / drive Z320064S-TTF=192hrs / drive W3007B7L-TTF=448hrs / drive W3007B2R-TTF=532hrs



Lombard Reliability Pareto (Gen3-MAT3.4) - March



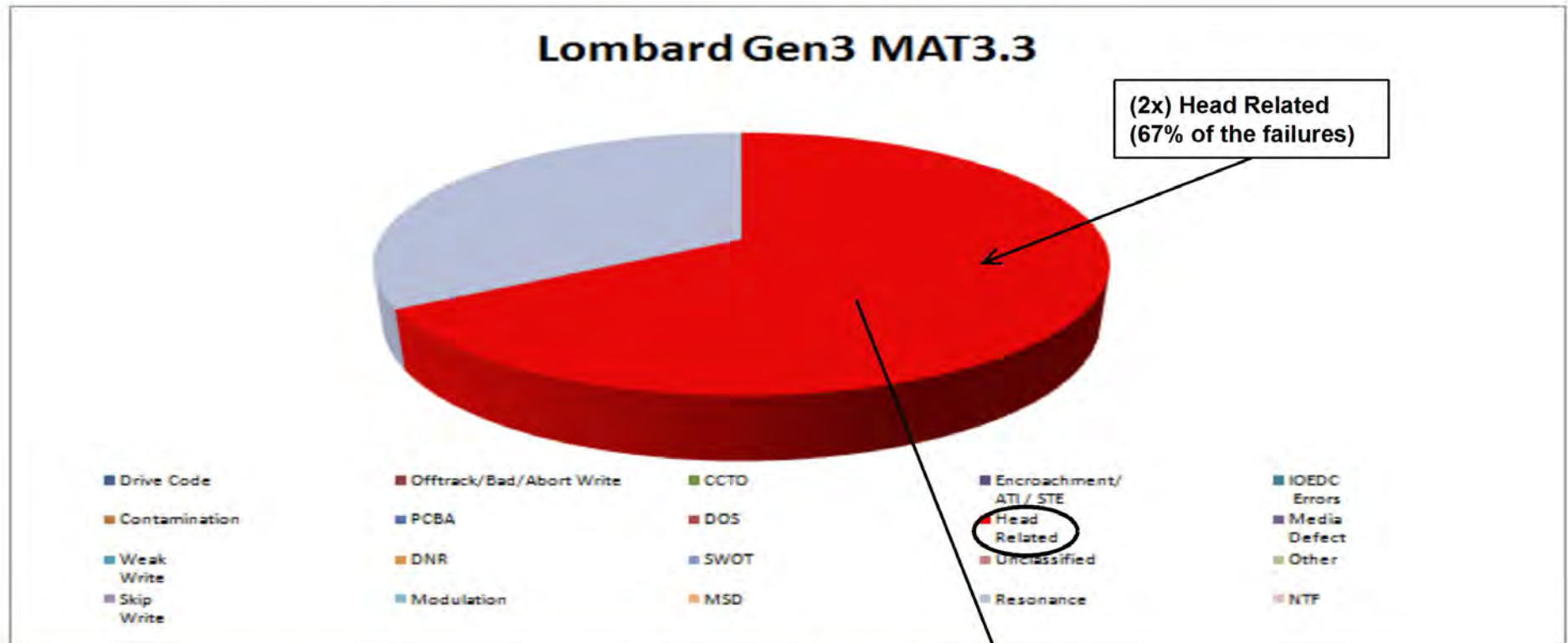
Lombard Head Related Reliability Failures – 0 failure out of 409 Gen3 MAT3.4 drives. (4 failures total).

Actions that have or will be taken to date include

- Zero head related reported to date.

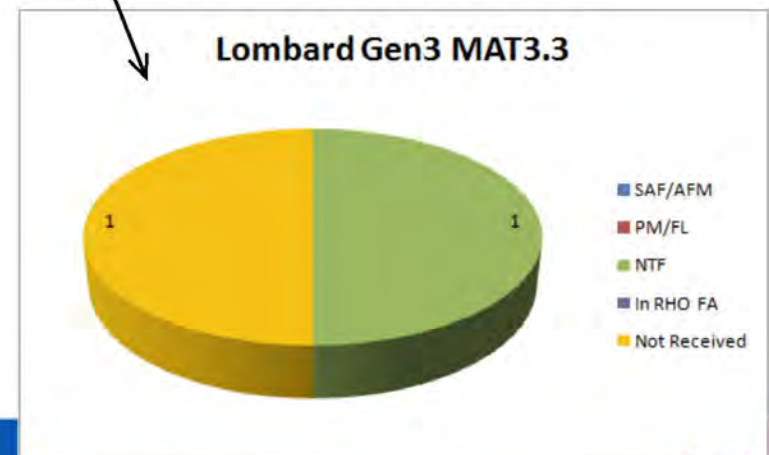


Lombard Reliability Pareto (Gen3-MAT3.3) - March



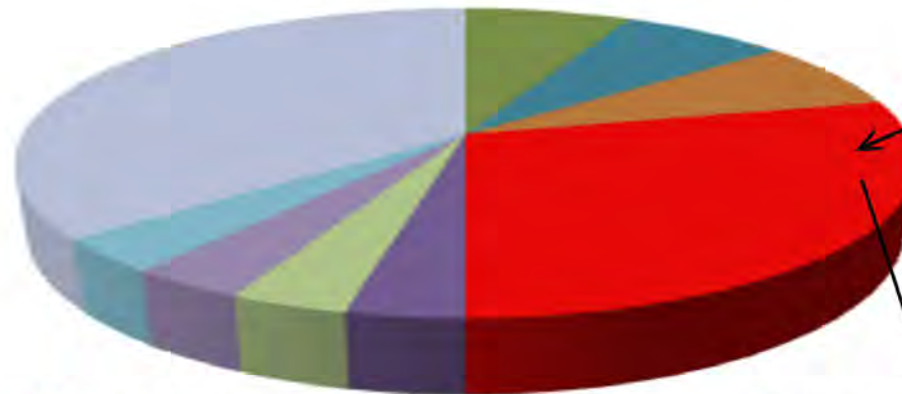
Lombard Head Related Reliability Failures – 2 failures out of 484 Gen3 MAT3.3 drives. (3 failures total).
 Actions that have or will be taken to date include

- (2x) Unstable head: Drive Z3008Q58-TTF=17hrs / drive Z30086FT-TTF=140hrs
 - Drive Z30086FT – **Conclusion: NTF.**

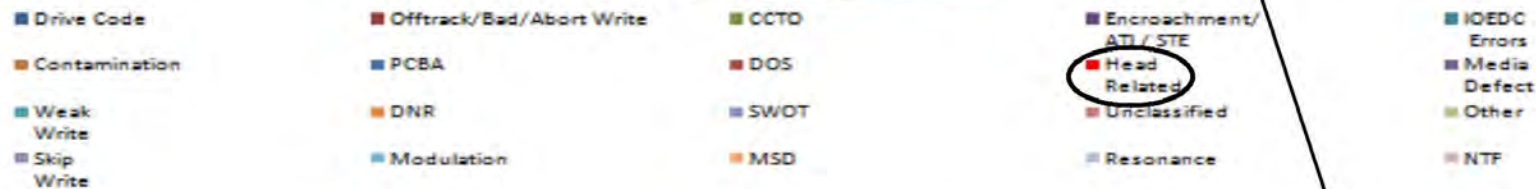


Lombard Reliability Pareto (Gen3-MAT3.2) - March

Lombard Gen3 MAT3.2



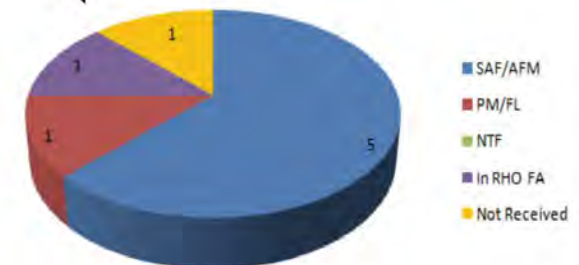
(8x) Head Related
(29% of the failures)



Lombard Head Related Reliability Failures – 8 failures out of 985 Gen3 MAT3.2 drives. (28 failures total).
Actions that have or will be taken to date include

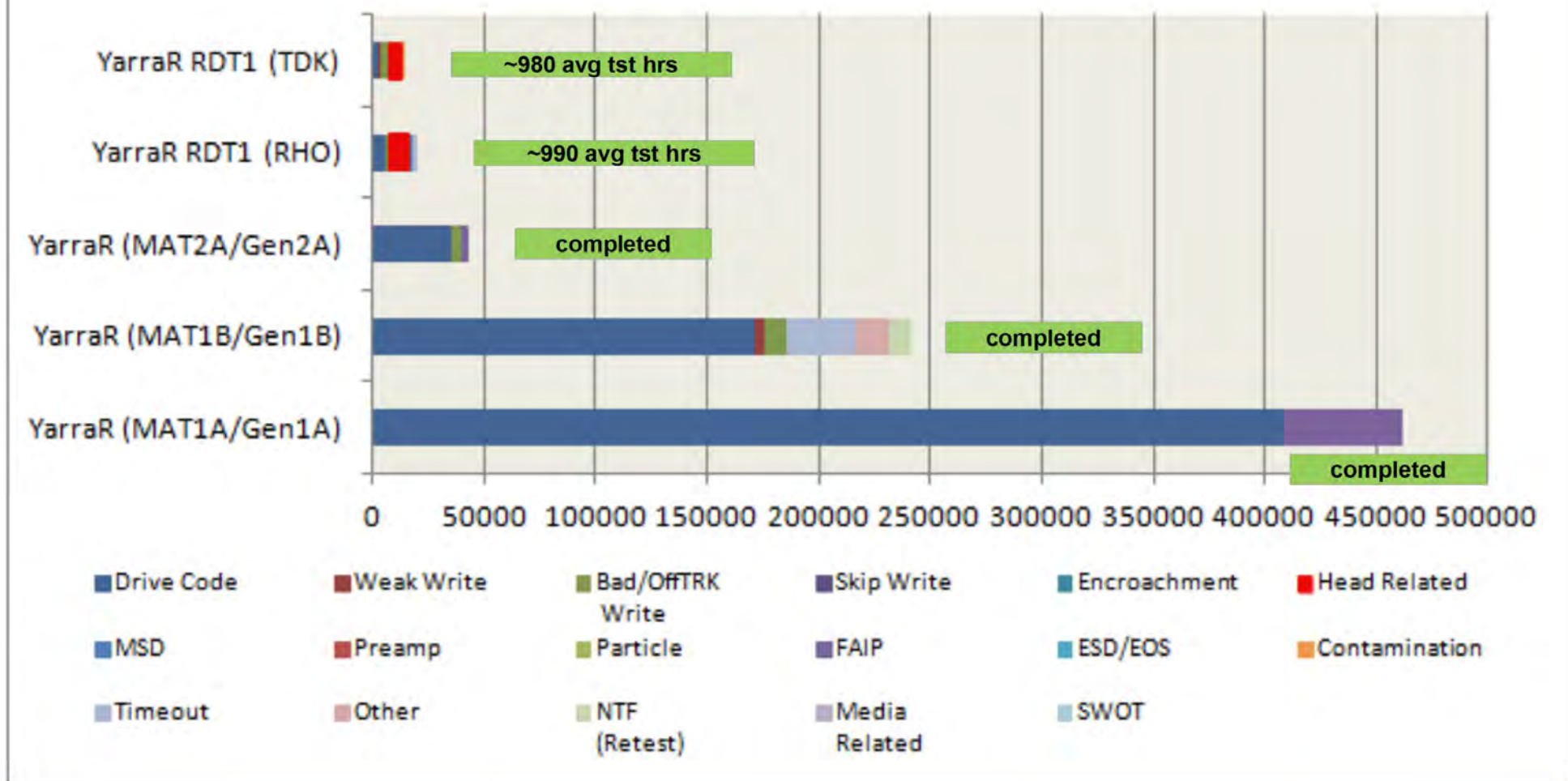
- (3x) Degraded heads: Drive Z32004EQ-TTF=18hrs / Drive Z3006K0Q-TTF=467hrs / Z31005MK-TTF=612hrs
 - Drive Z32004EQ – **Conclusion: SAF/AFM. CA: Fairlane.**
 - Drive Z3006K0Q – **Conclusion: PM (with interaction as a possible factor). CA: Fairlane.**
 - Drive Z31005MK – In RHO FA.
- (5x) Unstable Heads: Drive Z31005Q7-TTF=281 hrs / Drive Z3006K3K-TTF=141hrs / Drive Z3006K8V-TTF=625 hrs / Drive W32002SA-TTF=329 hrs / Drive W31001MK-TTF=552 hrs.
 - Drive Z31005Q7 – **Conclusion: SAF/AFM. CA: Fairlane.**
 - Drive Z3006K3K – **Conclusion: SAF/AFM. CA: Fairlane.**
 - Drive W32002SA – **Conclusion: SAF/AFM. CA: Fairlane.**
 - Drive W31001MK – **Conclusion: SAF/AFM. CA: Fairlane.**

Lombard Gen3 MAT3.2



YarraR Reliability Pareto - Multiple Test Beds

New Product Reliability Pareto - April 2013



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Page 9



FED_SEAG0056571

YarraR Reliability Pareto RDT1 (RHO) - April

YarraR RDT1 (RHO)

(5x) Head Related
(45% of the failures)



YarraR Head Related Reliability Failures – 5 failures out of 548 RDT1 drives. (11 failures total).

Actions that have or will be taken to date include:

• (4x) Degraded Heads: SOF328472-TTF=11hrs / SOF332385-TTF=466hrs / SOF332075-TTF=346hrs / SOF328239-TTF=32hrs.

• SOF328472: Drive FA: SAF/AFM. CA: Fairlane (post SAD).

• SOF332385: Drive FA: TCC opt. increased from 5dac to 10dac for better clearance at high temp in RDT2/SAD1.

• SOF328239: Drive FA: PM/FL. CA: Fairlane (post SAD).

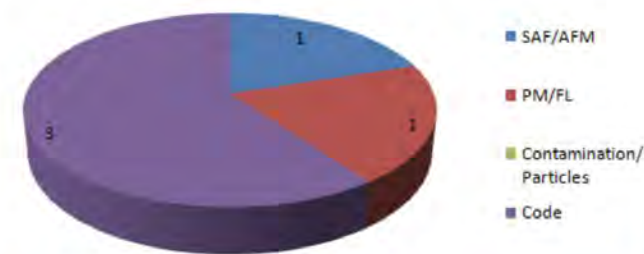
• SOF332075: Drive FA: TCC opt. increased from 5dac to 10dac for better clearance at high temp in RDT2/SAD1.

• (1x) Unstable Head: SOF331639-TTF=279hrs

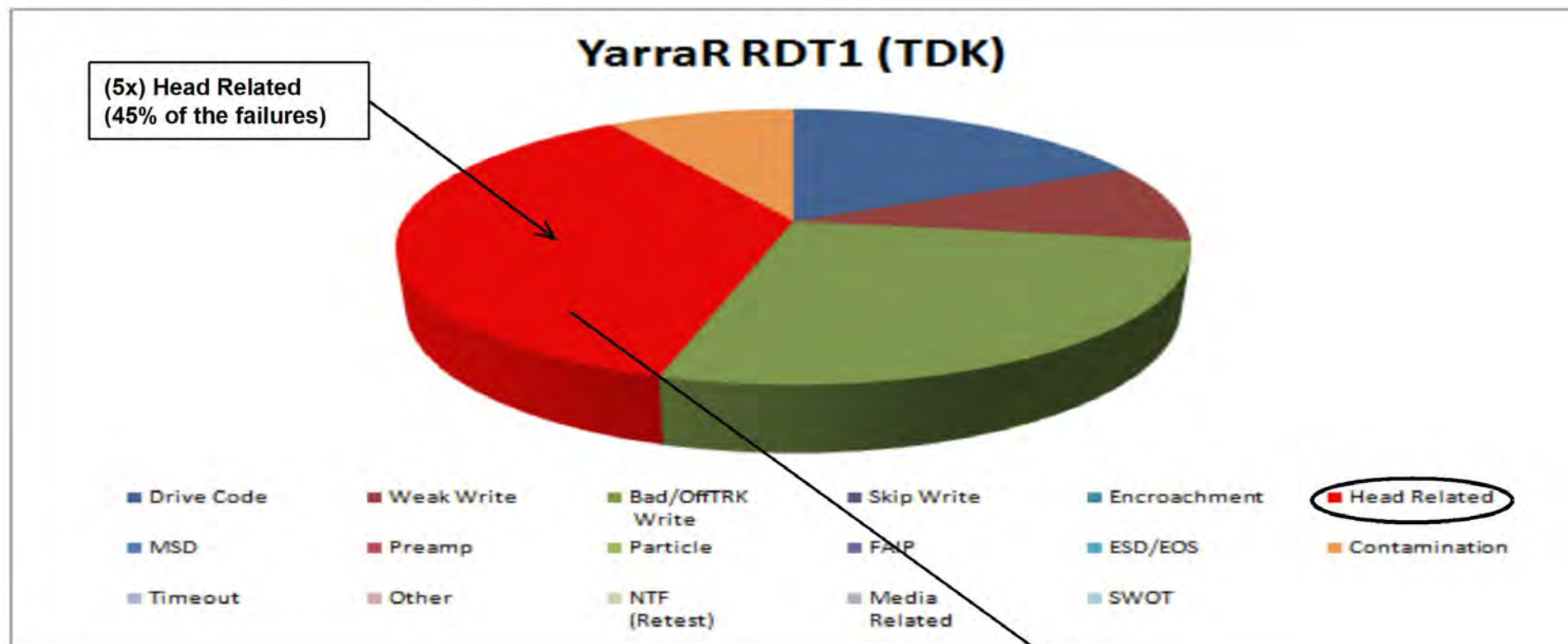
• SOF331639: Drive FA: Opt SOVA count to trigger head baking to mitigate head stab.

In OEM RDT2/SAD1.

YarraR RDT1 (RHO)



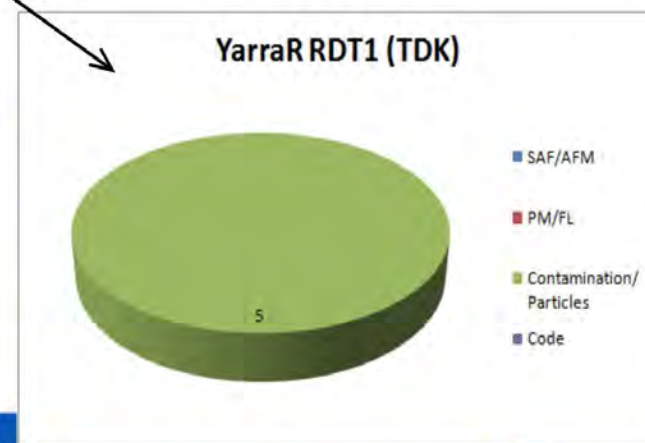
YarraR Reliability Pareto RDT1 (TDK) - April



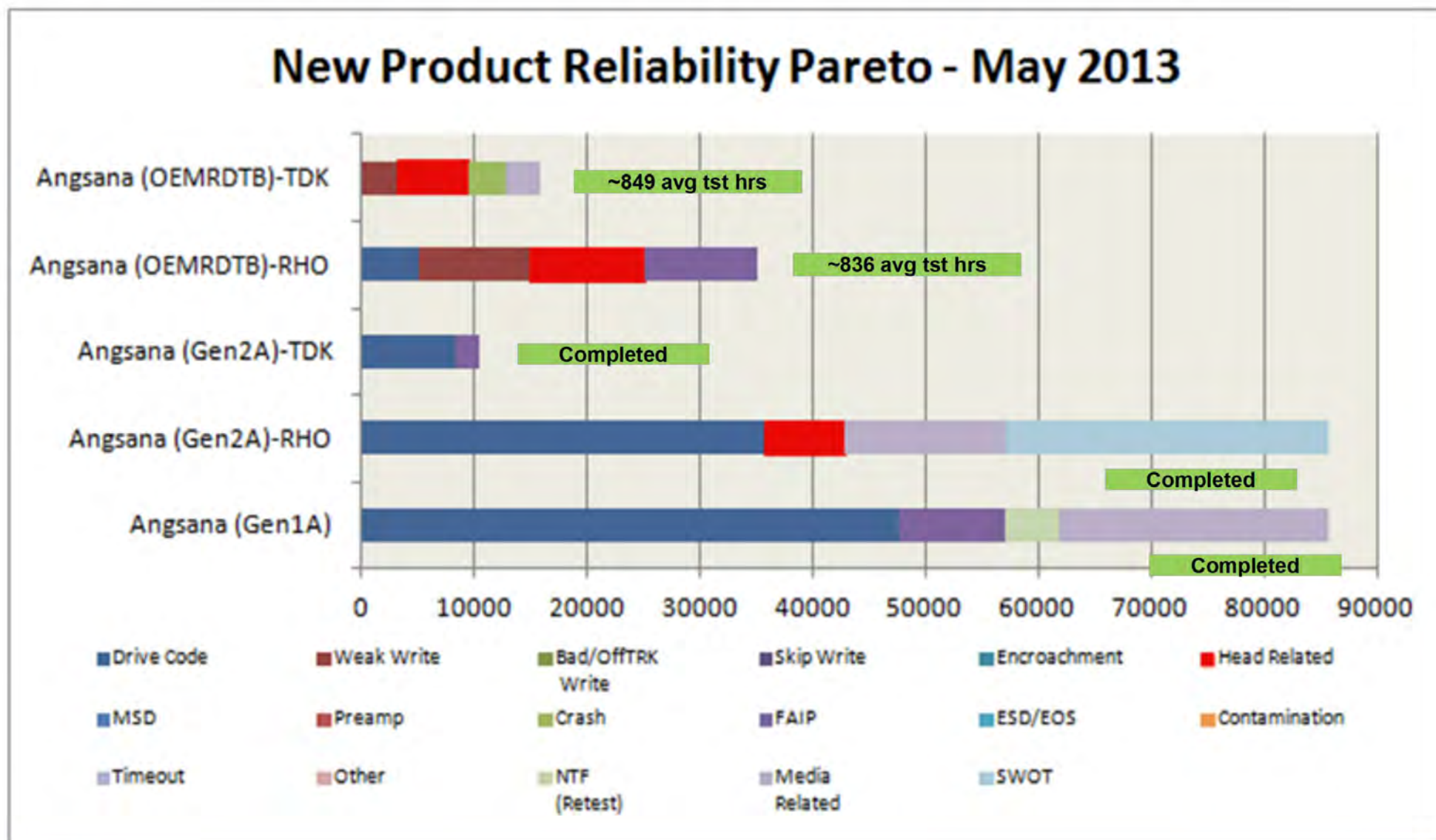
YarraR Head Related Reliability Failures – 5 failures out of 752 RDT1 drives. (11 failures total).

Actions that have or will be taken to date include:

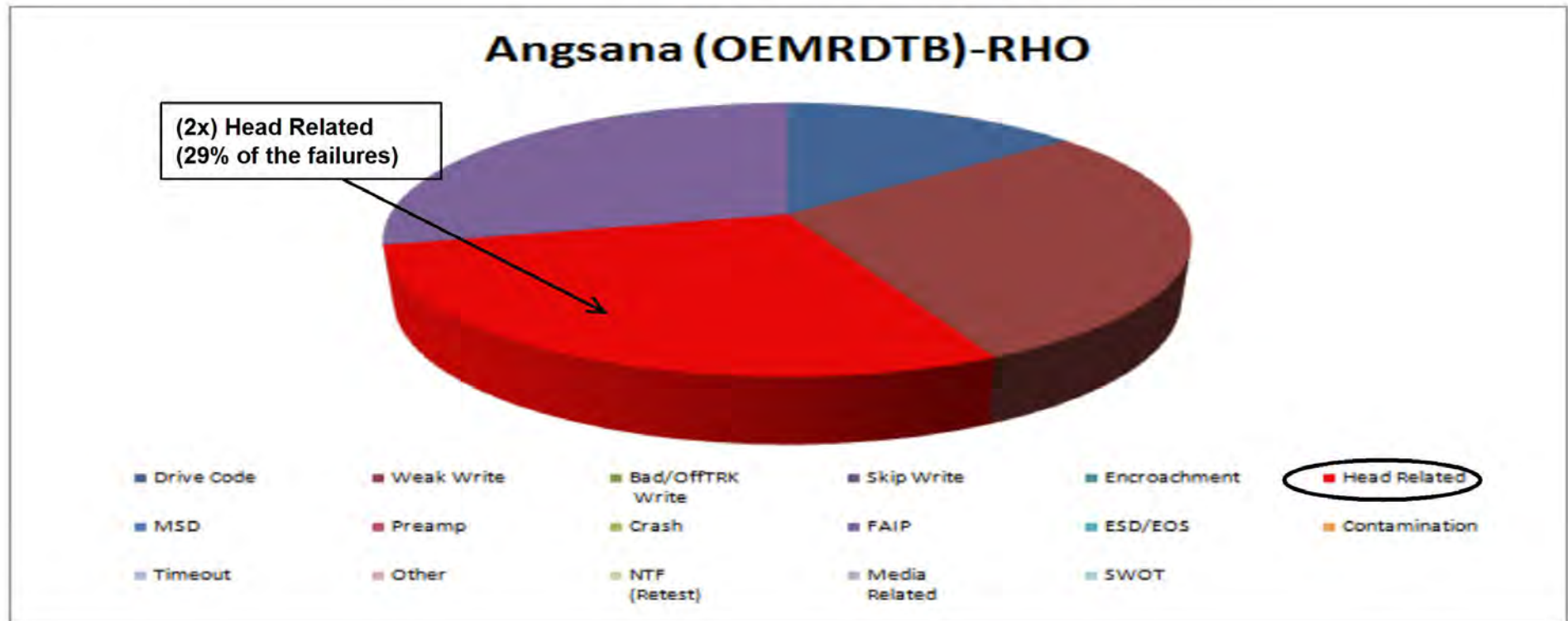
- (3x) Degraded Heads: SOF329820-TTF=272hrs / SOF333411-TTF=496hrs / SOF333405-TTF=556hrs
 •SOFs 329820/333411/333405: **TDK Head. CA: Kaifa 100% slider dip clean added into wash process In Wuxi SBS ODT/ORT Demo.**
- (2x) Unstable Head: SOF328731-TTF=22hrs / SOF337314-TTF=575hrs
 • SOF328731/337314: **TDK Head. CA: CA: Kaifa 100% slider dip clean added into wash process in Wuxi SBS ODT/ORT Demo.**



Angsana Reliability Pareto - Multiple Test Beds



Angsana Reliability Pareto (OEMRDTB - RHO) - May



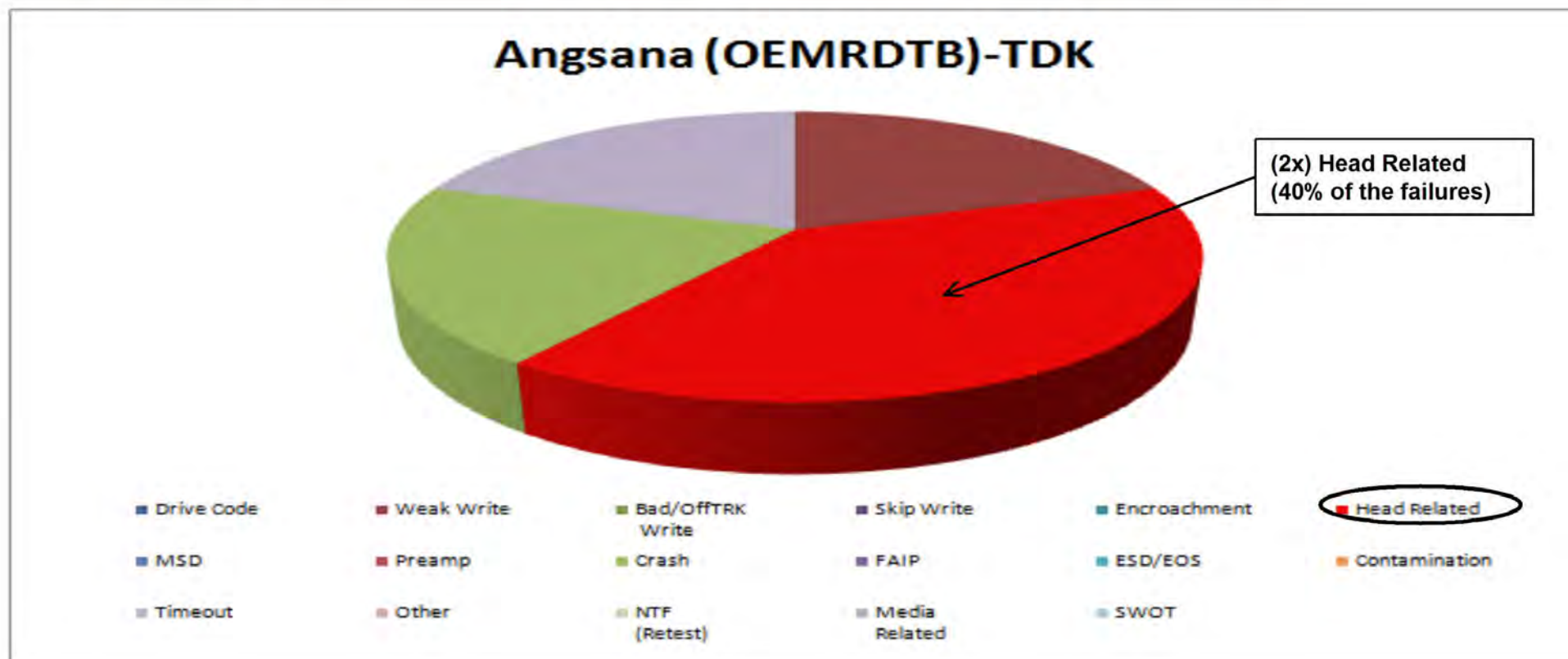
Angsana Head Related Reliability Failures – 2 failures out of 199 OEMRDTB drives. (7 failures total).

Actions that have or will be taken to date include:

- (2x) Unstable Head: SOF345044-TTF=30hrs / SOF345043-TTF=63hrs
 - SMT listed CAs: 1) Head stability paper sort in Gen3B. 2) Bar bake. 3) Fairlane (post SAD)



Angsana Reliability Pareto (OEMRDTB - TDK) - May



Angsana Head Related Reliability Failures – 2 failures out of 314 OEMRDTB drives. (5 failures total).

Actions that have or will be taken to date include:

(1x) Unstable Head: SOF345014-TTF=85hrs

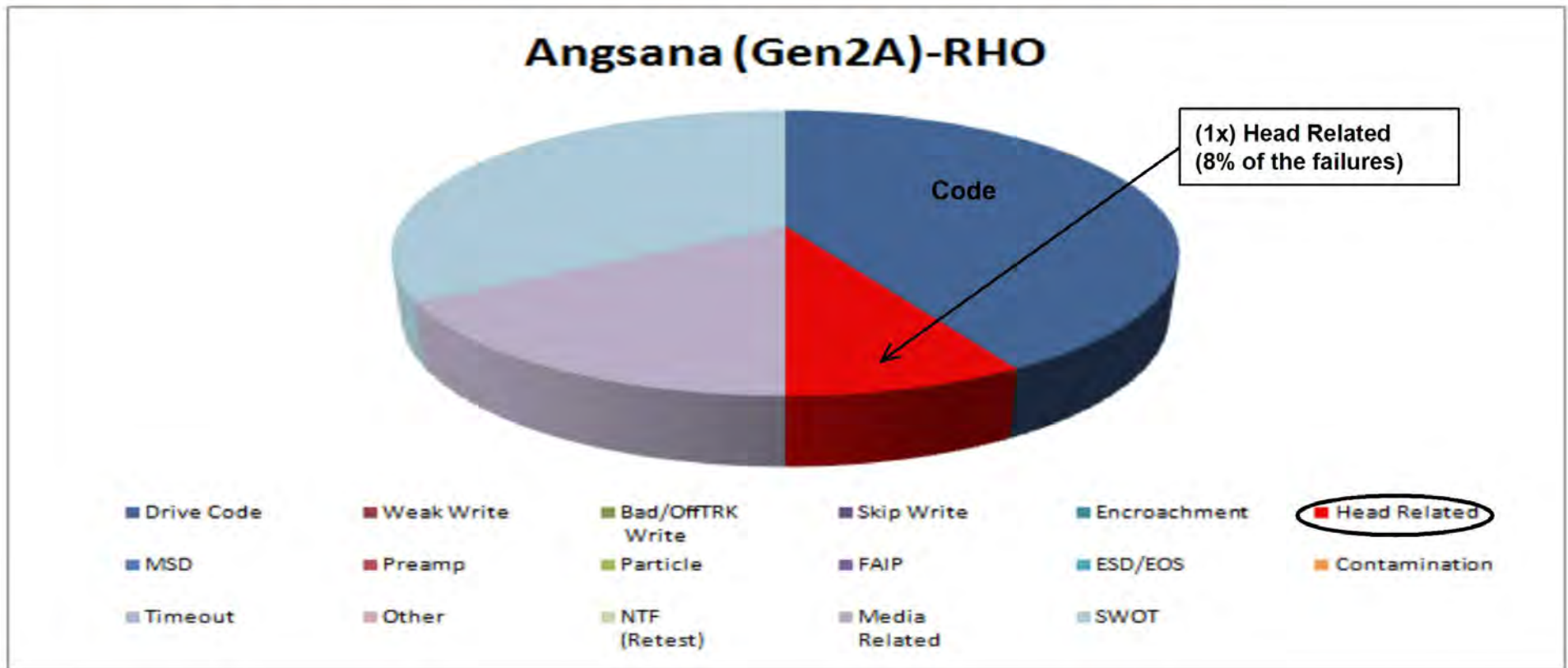
- SMT listed CAs: 1) Head stability paper sort in Gen3B. 2) ET spike noise spec opt.

(1x) Degraded Writer: SOF347012-TTF=301hrs

- SMT listed CAs: Fix in F3 code 141 – implement zero heater write induced prevention scheme in Gen3C.



Angsana Reliability Pareto (Gen2A RHO) - March



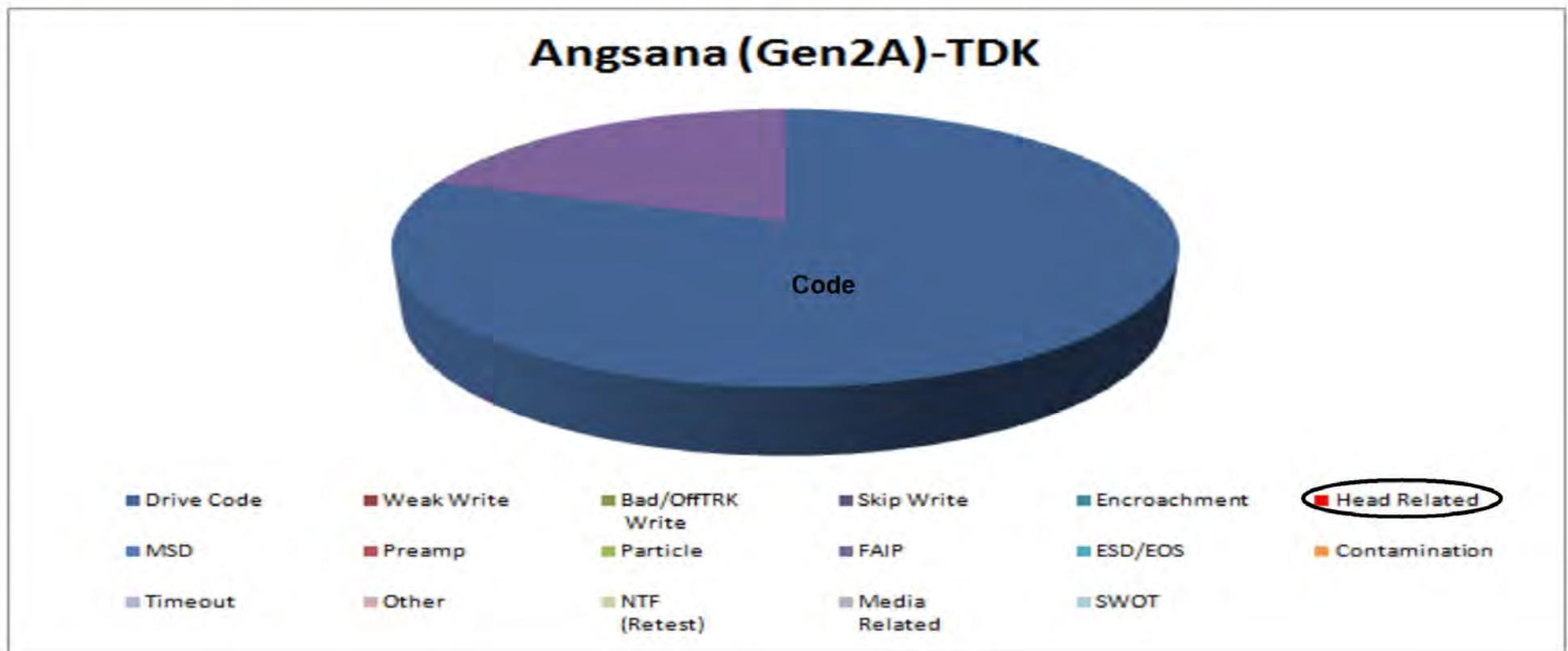
Angsana Head Related Reliability Failures – 1 failure out of 140 Gen2A drives. (12 failures total).

Actions that have or will be taken to date include:

- (1x) Unstable Head: SOF326568-TTF=95hrs
 - SOF326568: Drive FA only (RHO Head). CA: 1) Implement T250 screen count in Gen3A PCO. 2) Paper sort all Gen2A drives. 3) Enable head thermal shock recovery.



Angsana Reliability Pareto (Gen2A TDK) - March



Angsana Head Related Reliability Failures – 0 failures out of 479 Gen2A drives. (5 failures total).

Actions that have or will be taken to date include:

Zero head related to date.



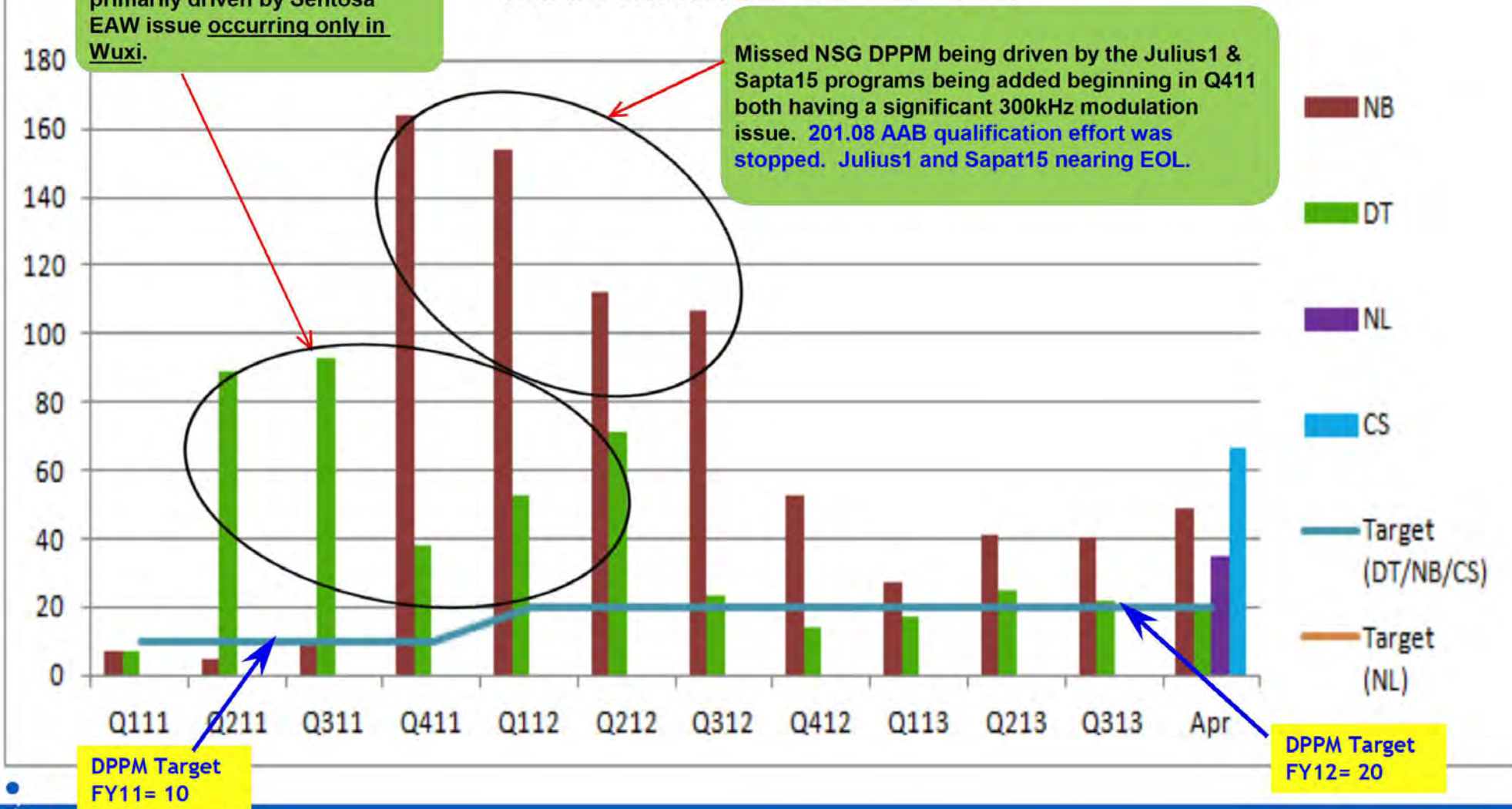


Released Products (Post SAD)

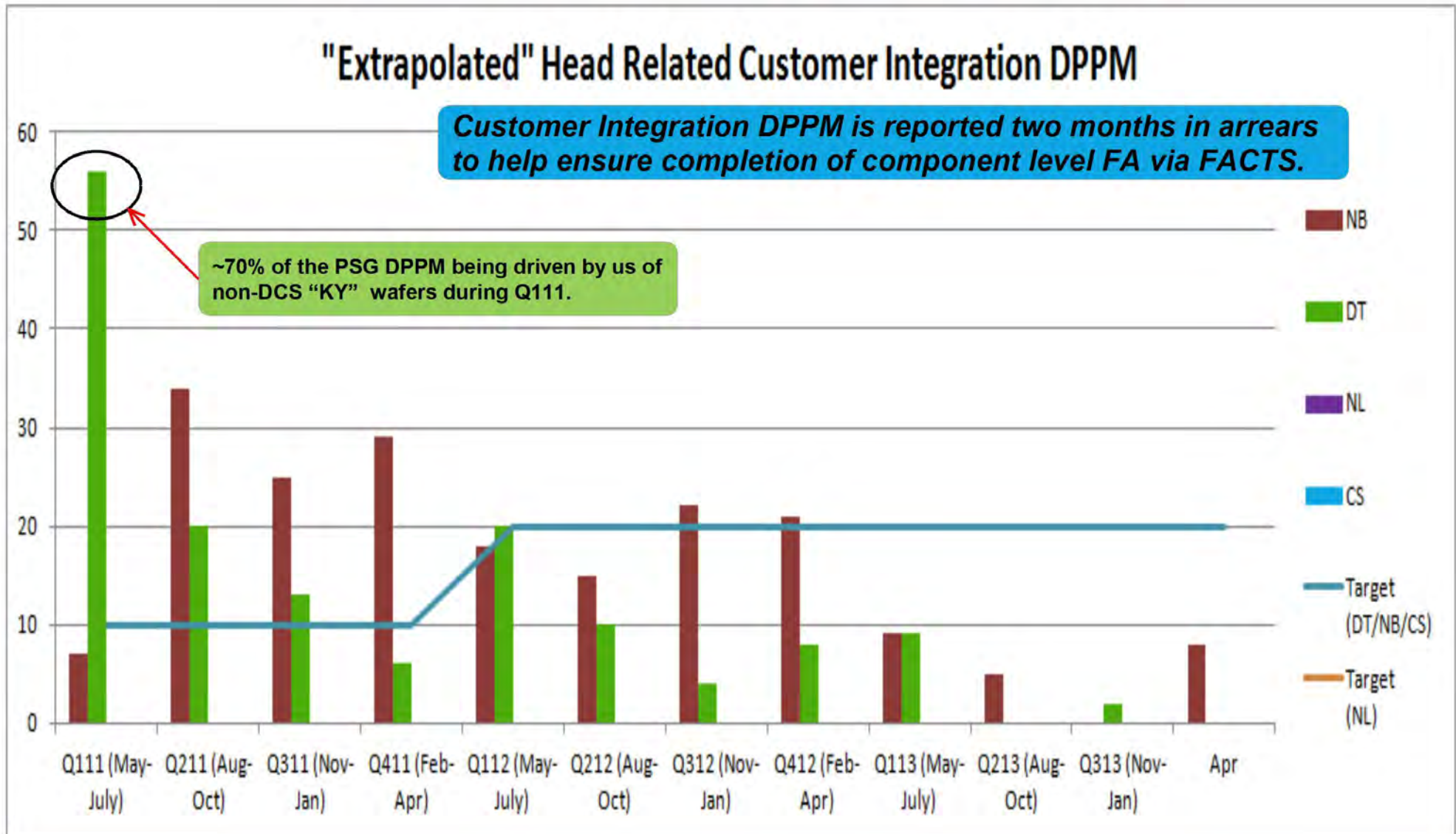


RHO Monthly Head Related ODT DPPM PSG/NSG (Confirmed Chargeable to RHO via FACTS)

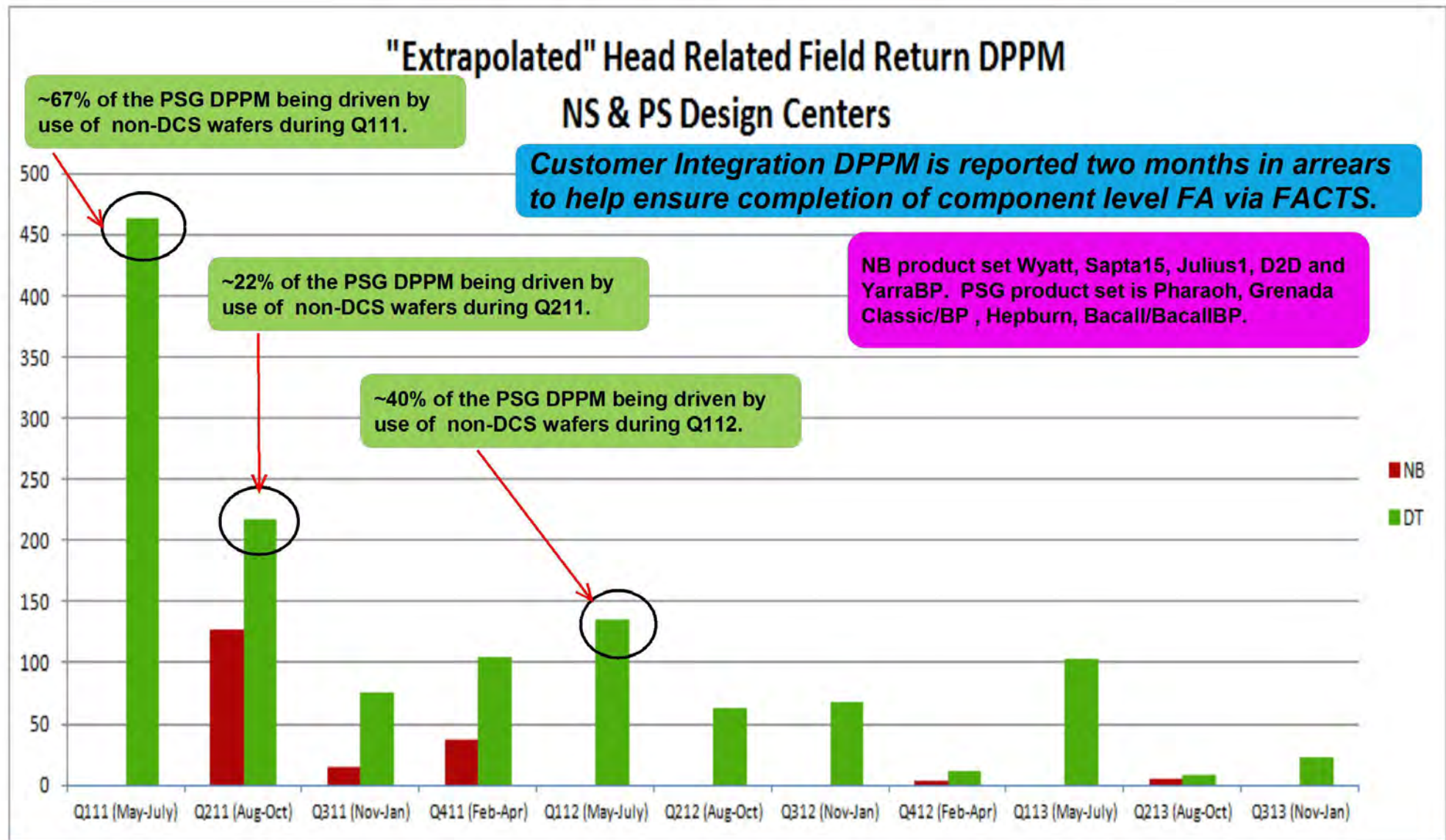
Head Related ODT DPPM



"Extrapolated" RHO Monthly Head Related CI DPPM PSG/NSG **(Confirmed Chargeable to RHO via FACTS)**

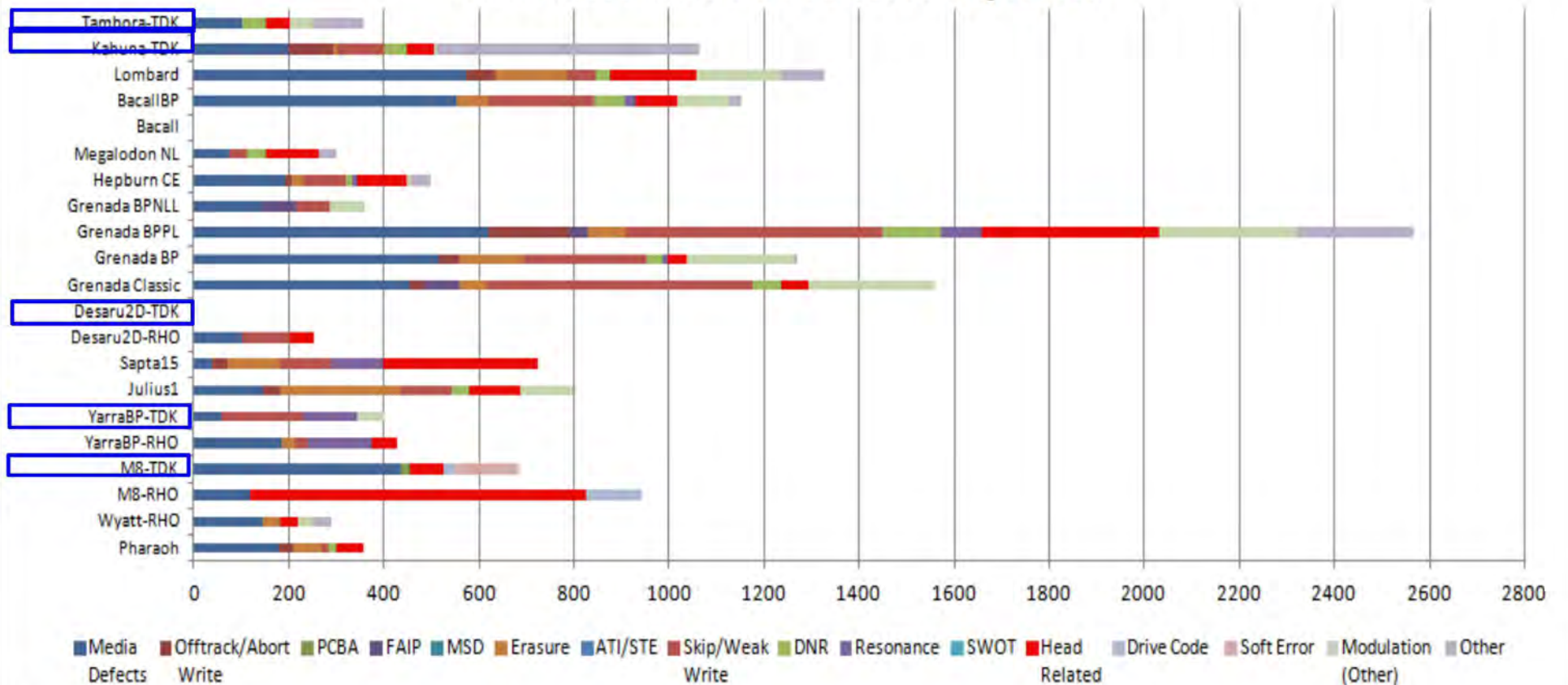


"Extrapolated" RHO Monthly Head Related Field Return DPPM PSG/NSG (Confirmed Chargeable to RHO via FACTS)



PSG/NSG/CSG Released Product ODT - April

Released Products ODT Pareto - April 2013

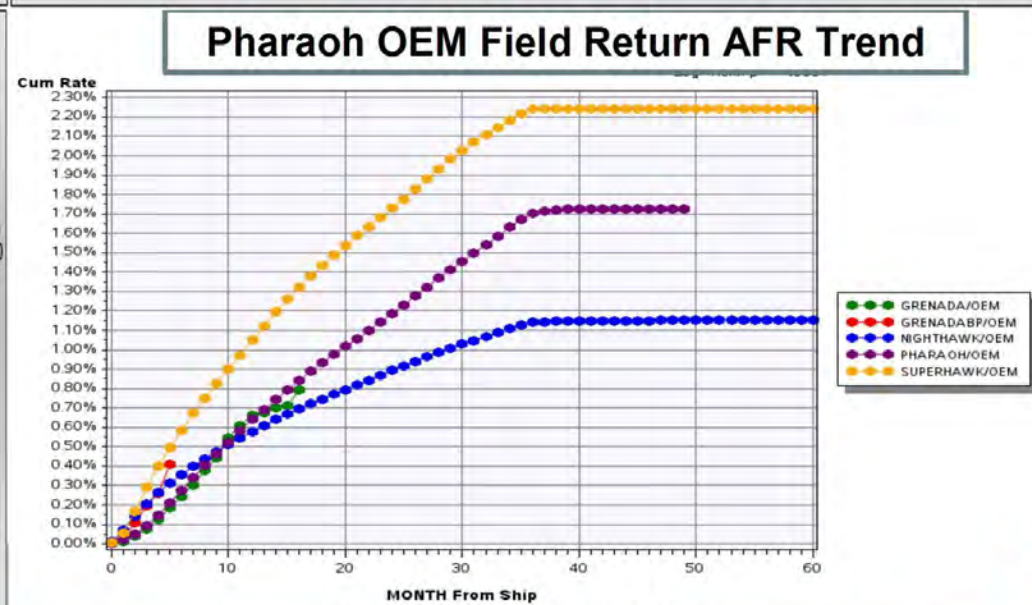
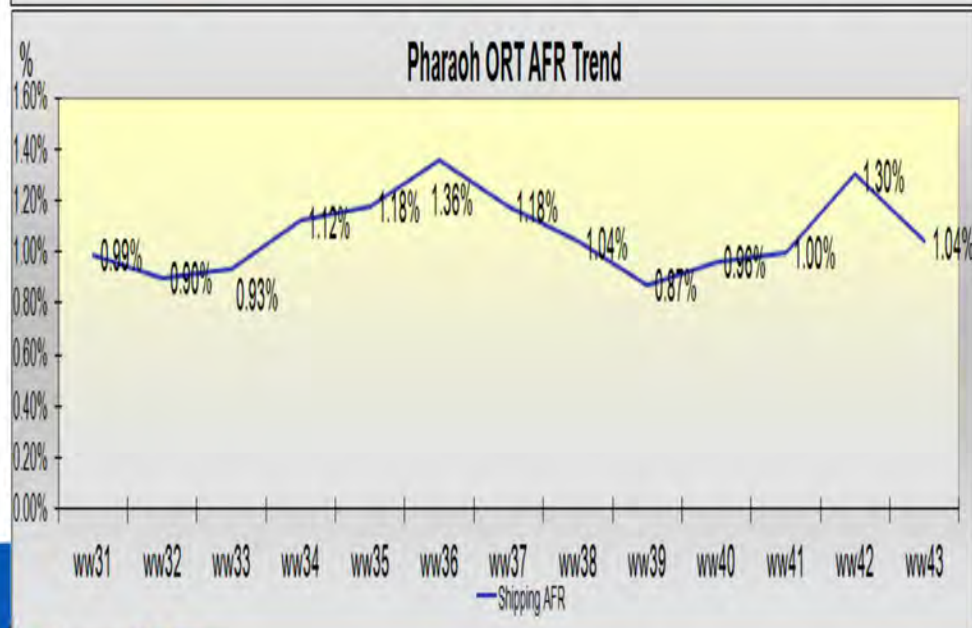
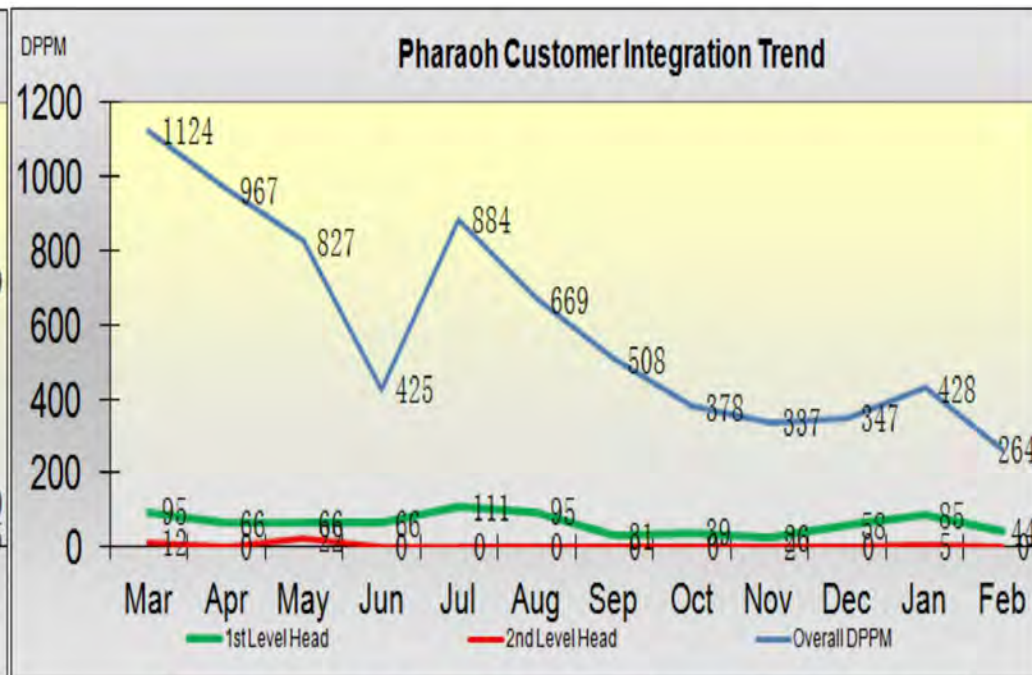
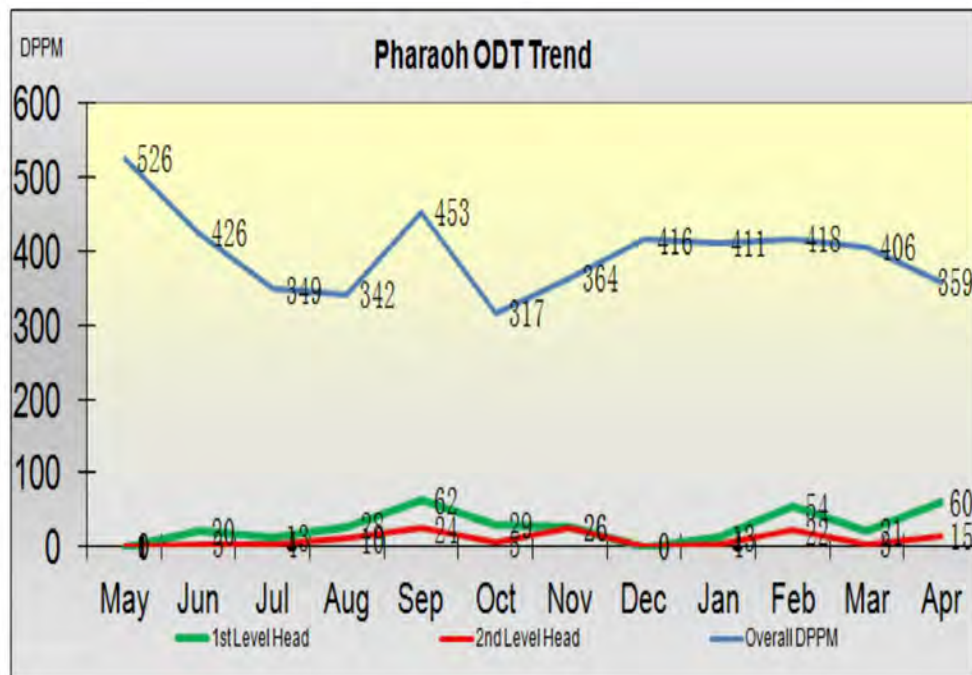


- ODT failure modes are drive center 1st level FA call-out

- “Head related” are those bucketed directly to heads by the 1st level drive FA. (The definition of head related can be wafer through HGA).

- It is recognized that some of the remaining failure modes, such as weak writes, skip writes, ATI, encroachment, etc; “can” include a head component, and therefore the top 1-2 will be tracked through to root cause conclusion. These fail modes get rolled up into the HDD (drive process) in the weekly drive center ODT reporting.

Pharaoh 1st/2nd Level Drive Trends (DPPM)

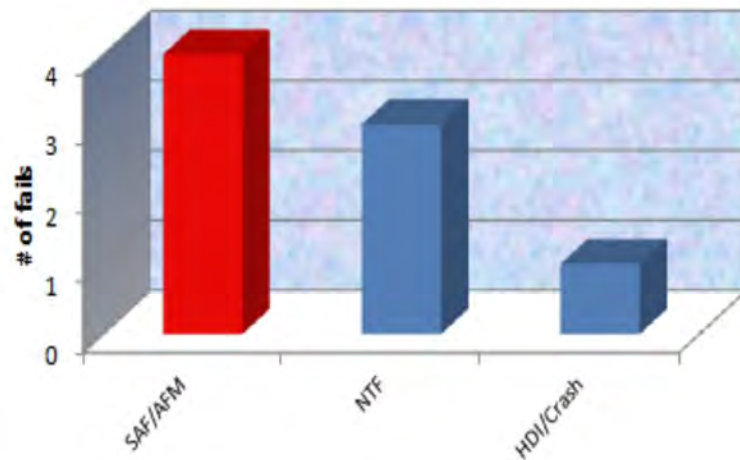


eCube E005355 Created: 03MAY13 14:12 Note: Incomplete Data Points are Excluded

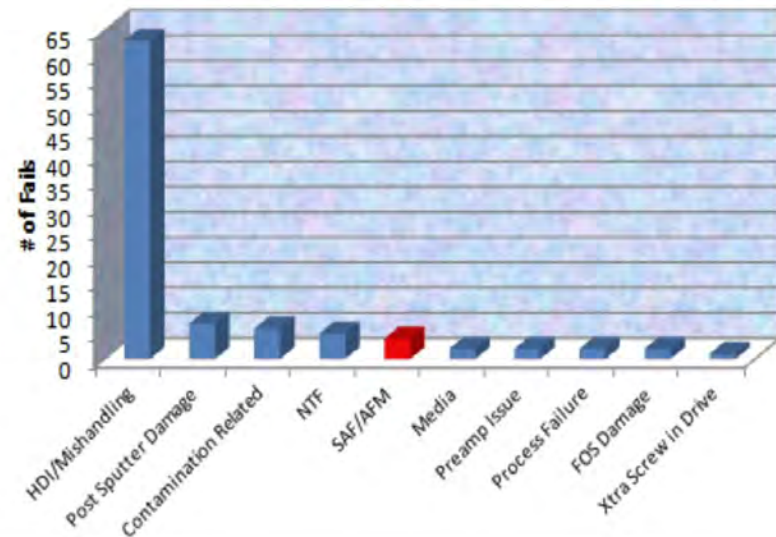
Pharaoh Head Level Pareto (DPPM)

Validated via FACTS

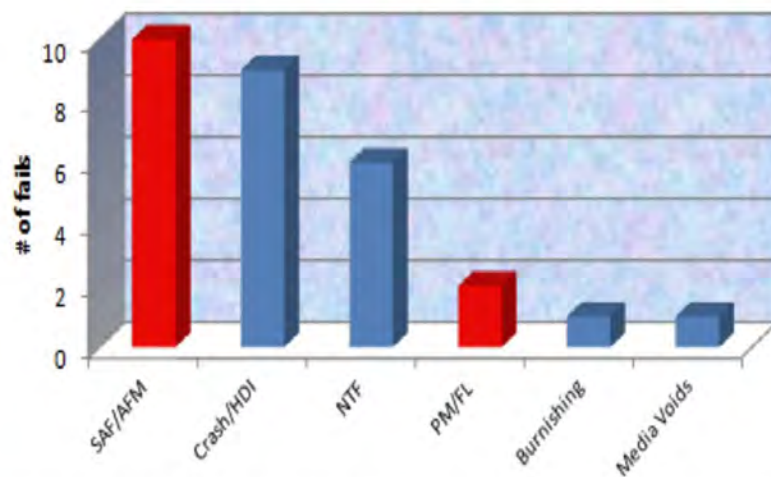
Pharaoh ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



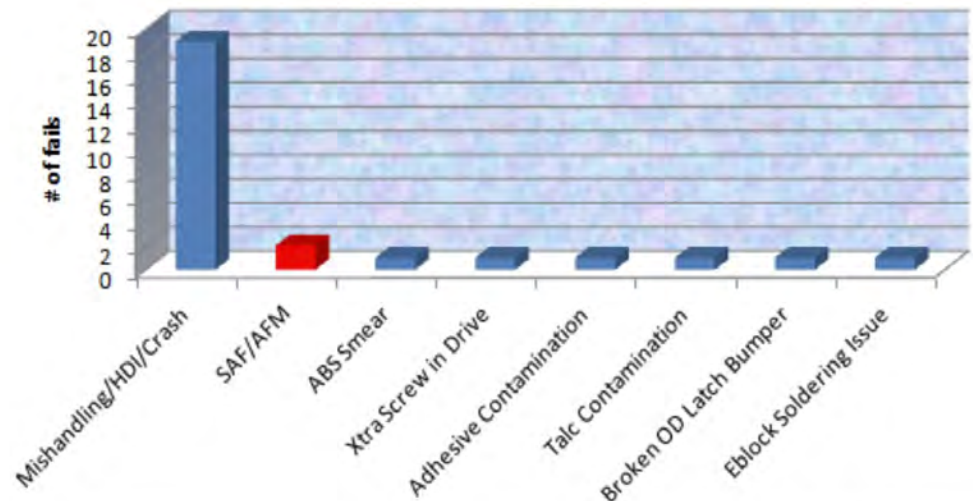
Pharaoh CI Component Level FAR
of Fails vs Type (Aug 12 - Feb 13)



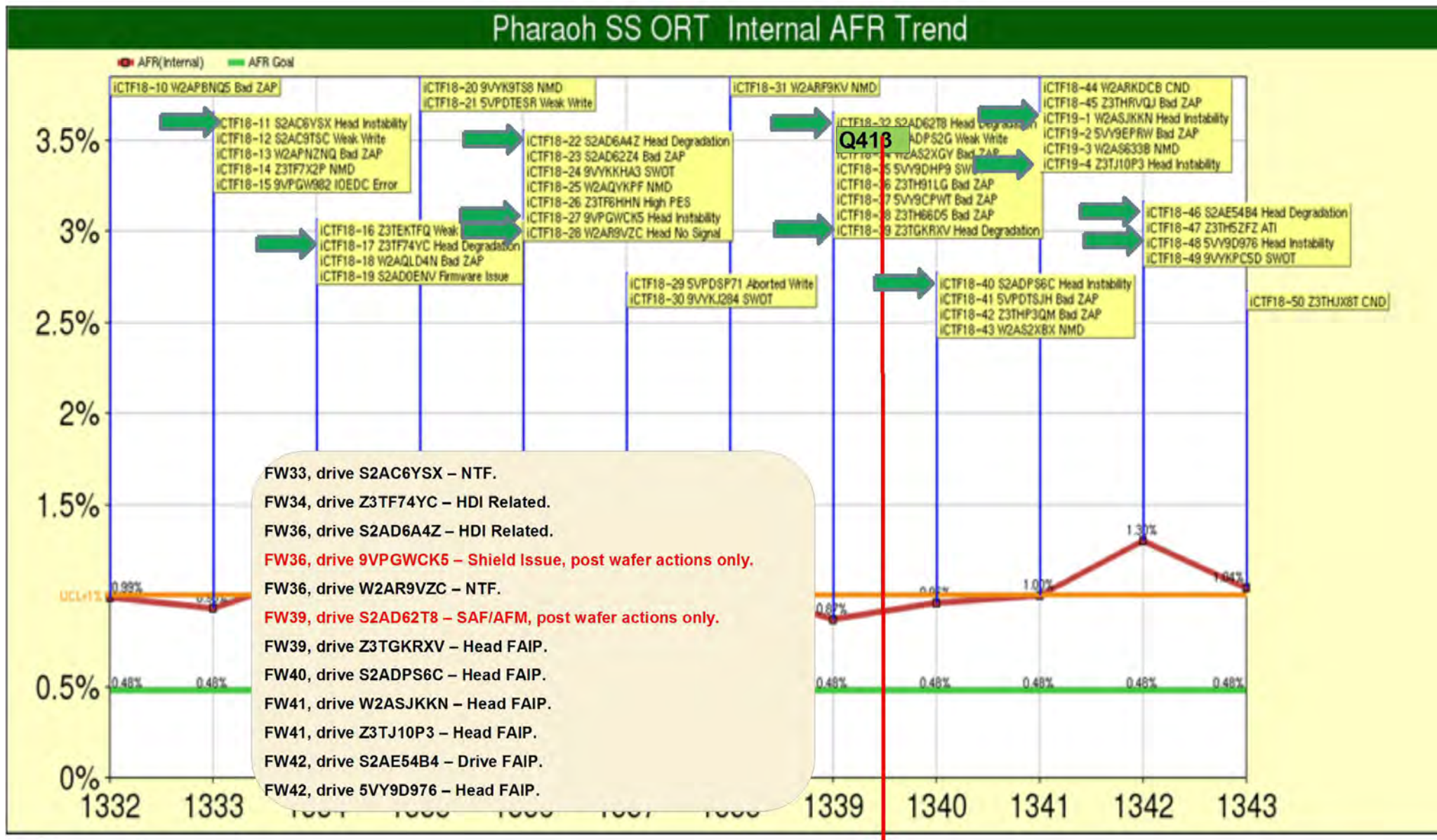
Pharaoh ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)

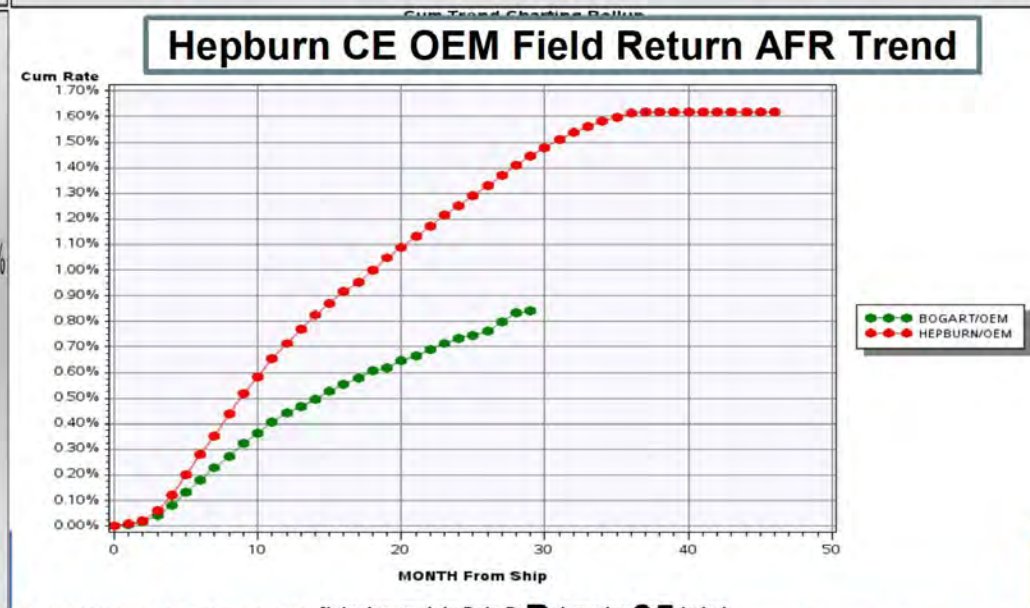
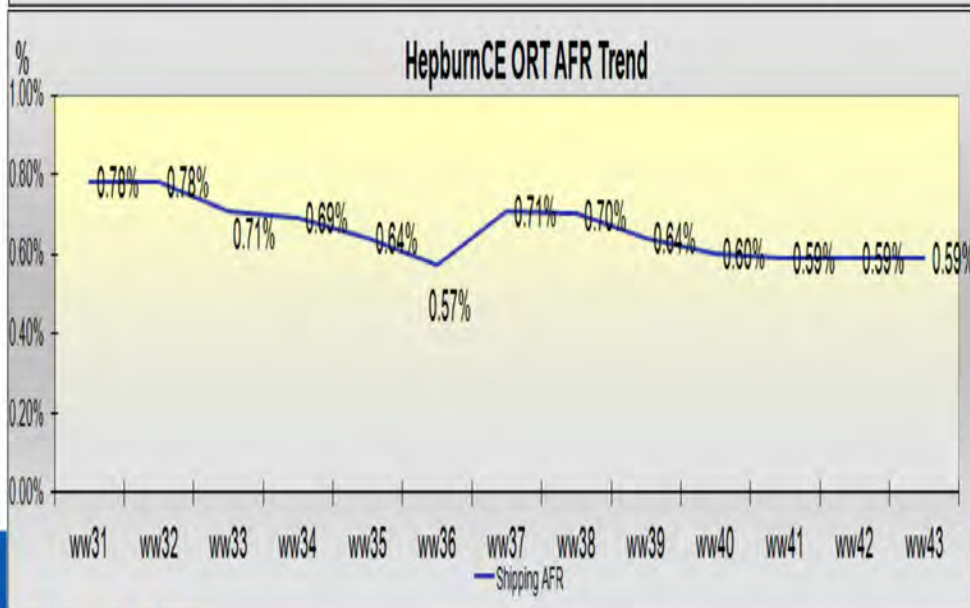
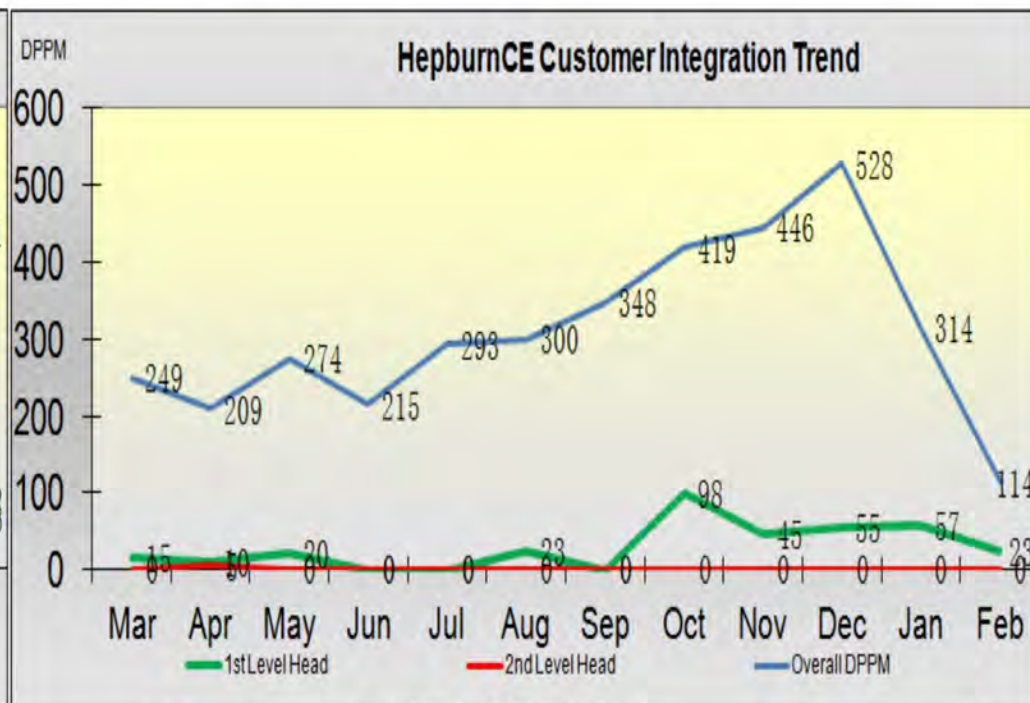
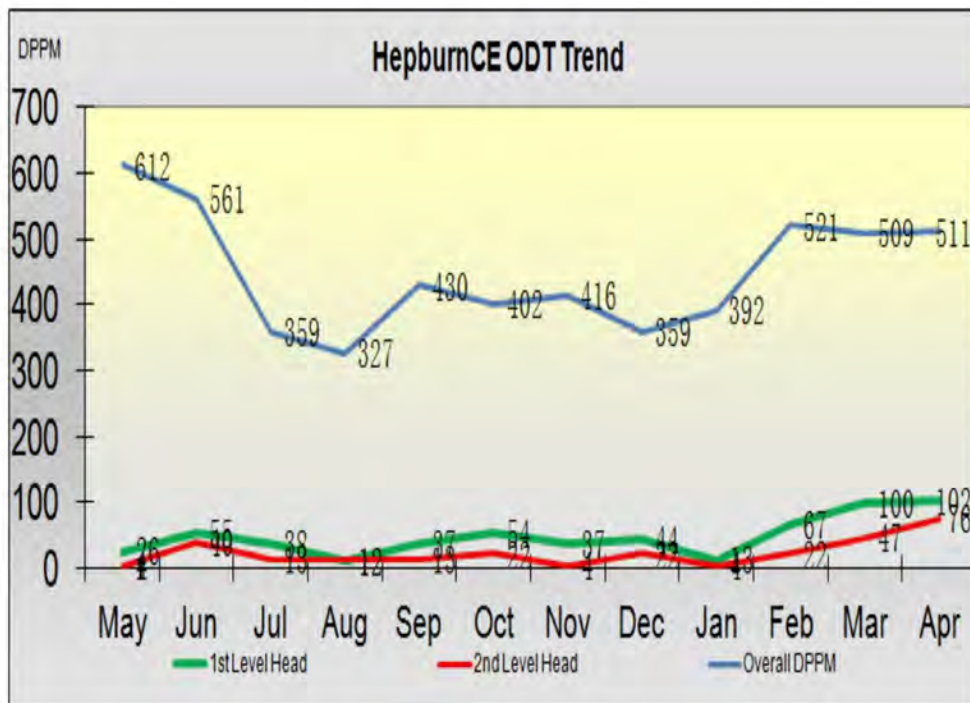


Pharaoh FR Component Level FAR
of Fails vs Type (Q113 - Q213)



Pharaoh ORT (Q413 RDT) (MTBF:230k hrs)

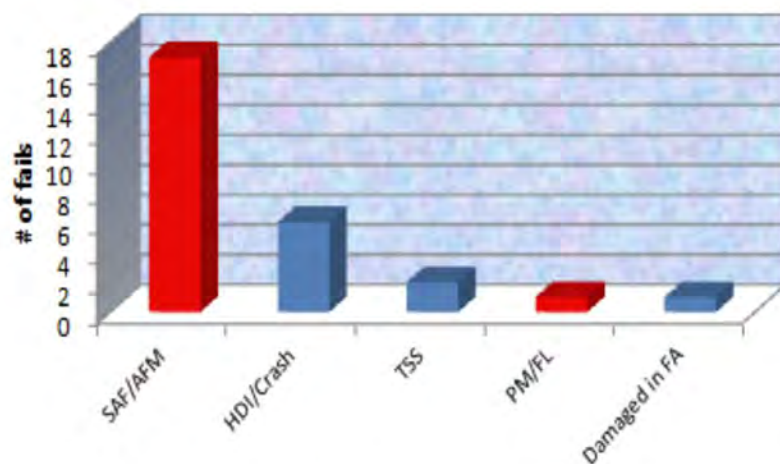




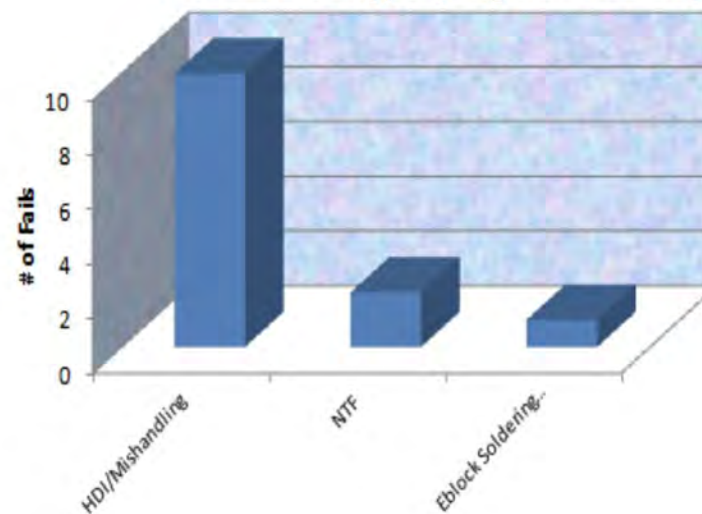
Hepburn CE Head Level Pareto (DPPM)

Validated via FACTS

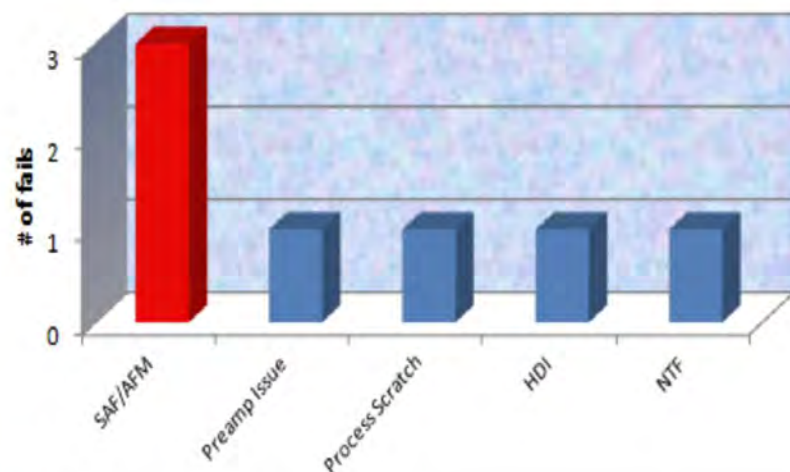
HepburnCE ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



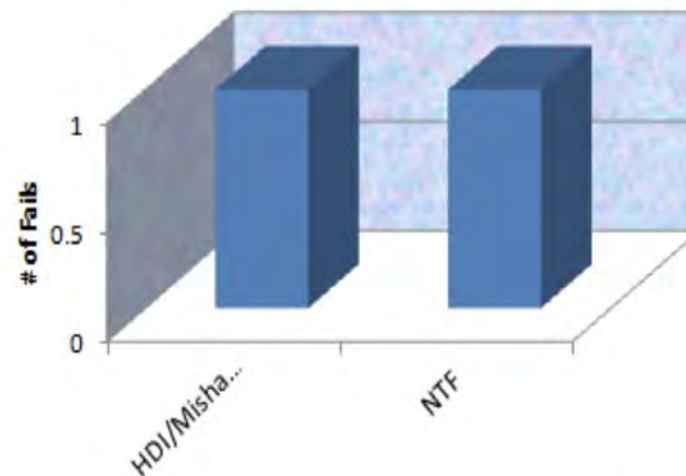
HepburnCE CI Component Level FAR
of Fails vs Type (Aug 12 - Feb 13)



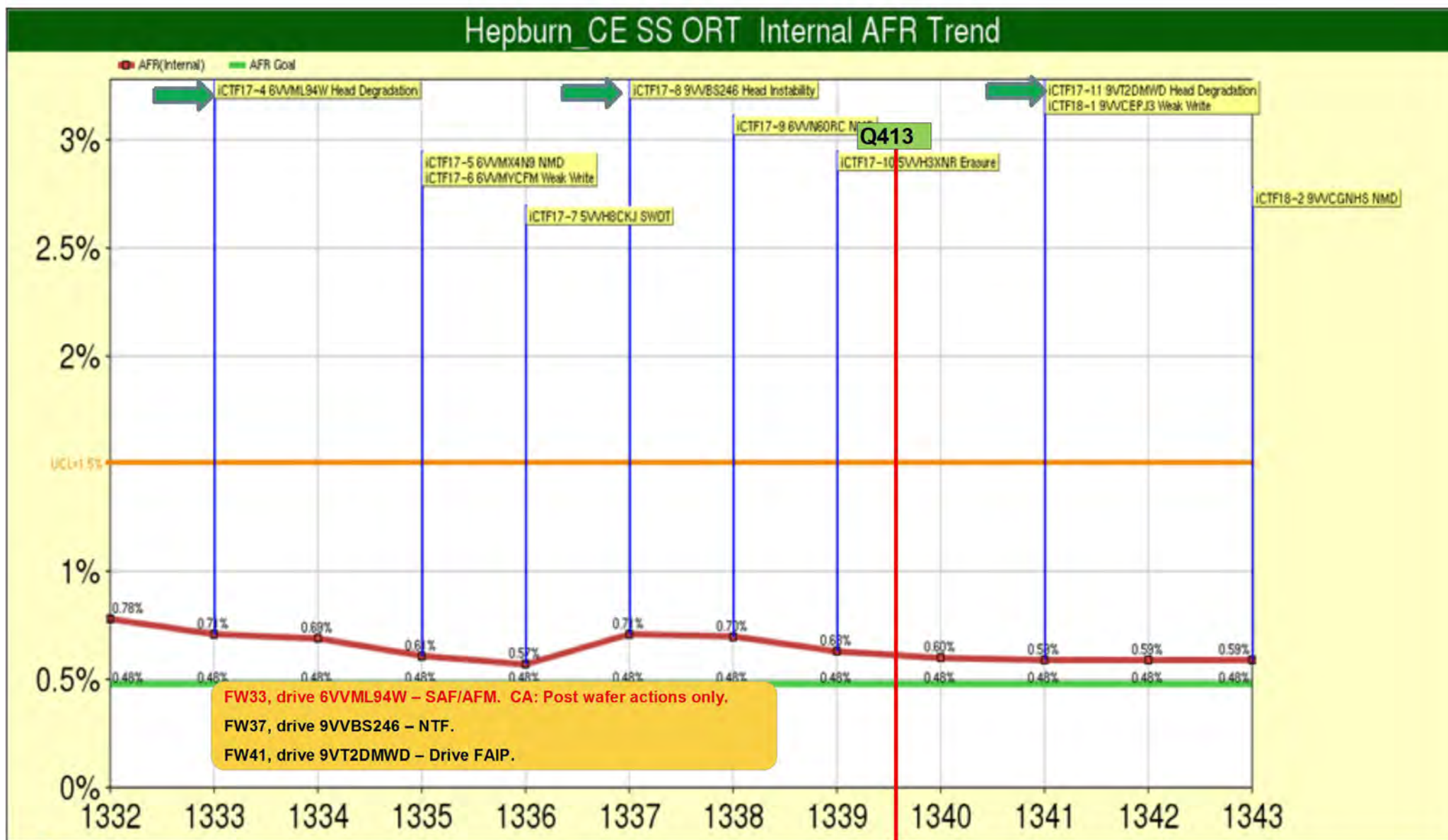
HepburnCE ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)

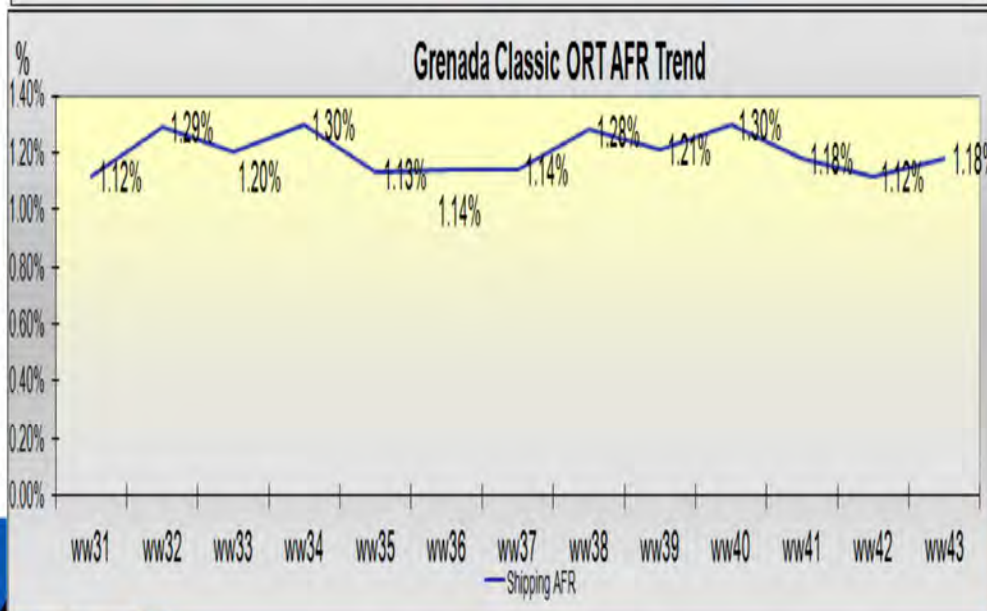
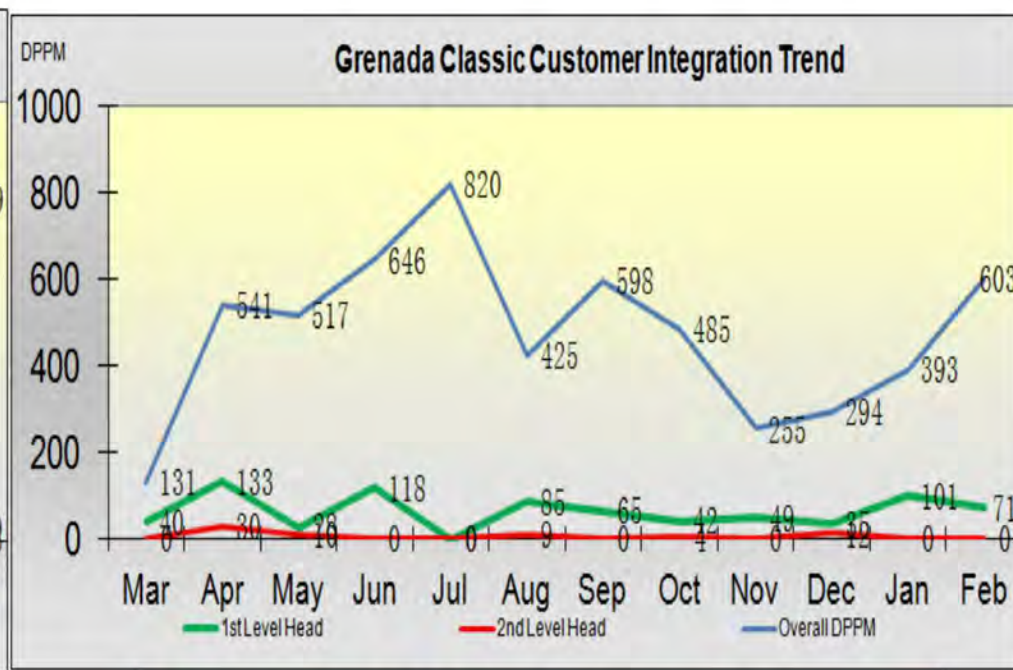
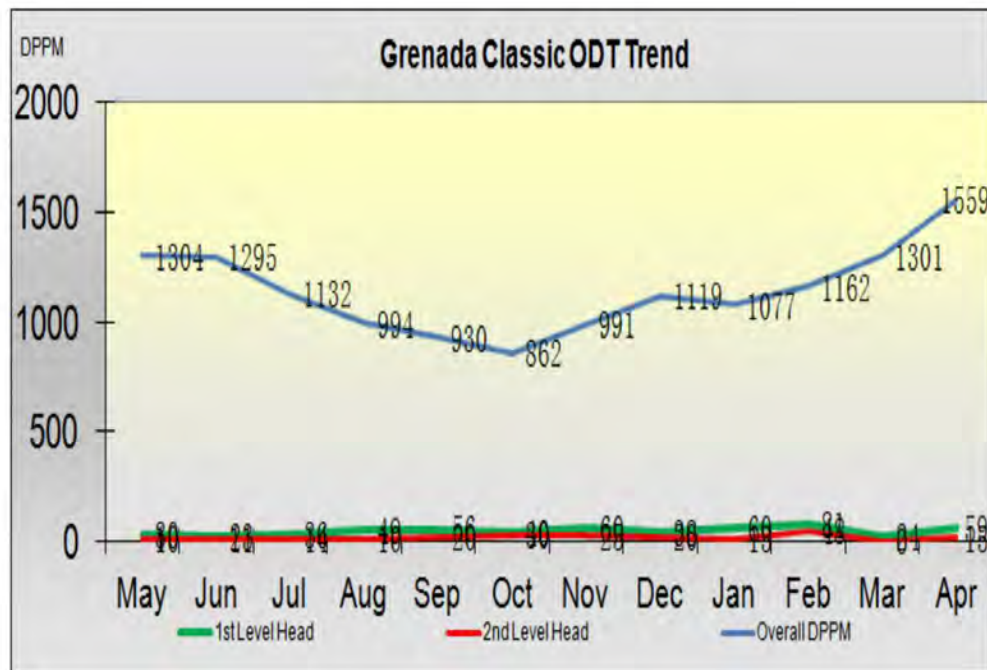


HepburnCE FR Component Level FAR
of Fails vs Type (Q113 - Q213)

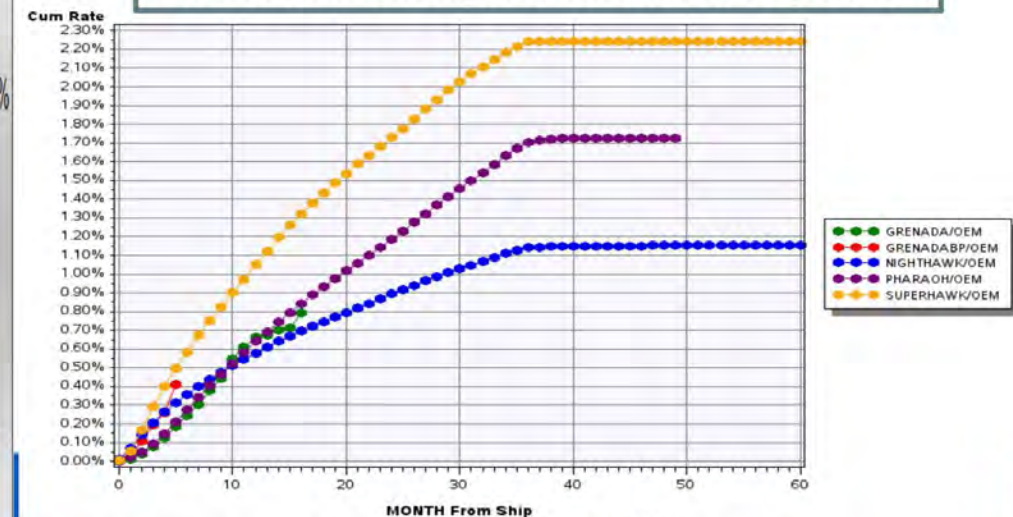


Hepburn CE ORT (Q413) (MTBF:1480k hrs)





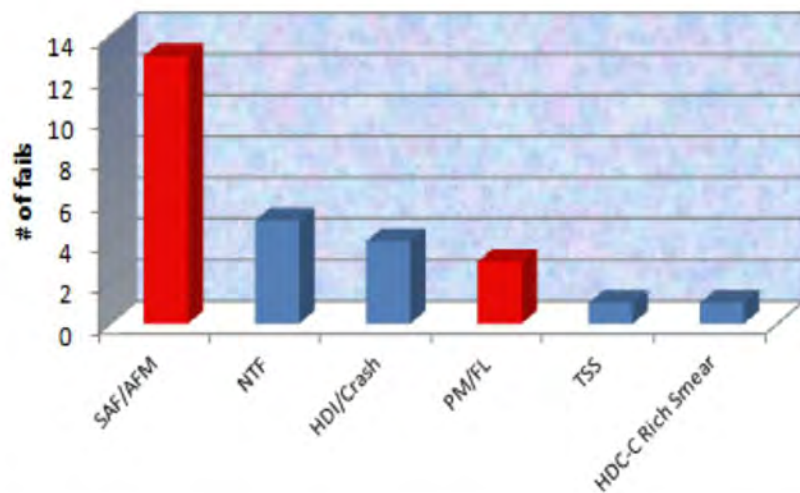
Grenada OEM Field Return AFR Trend



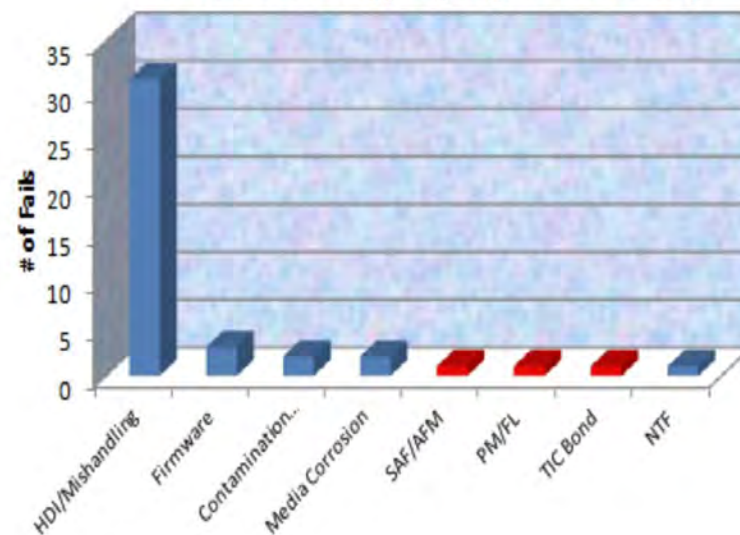
Grenada Classic Head Level Pareto (DPPM)

Validated via FACTS

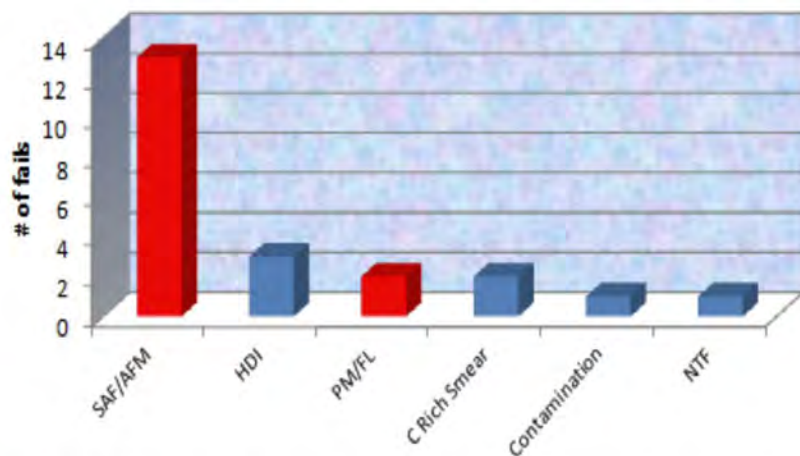
Grenada ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



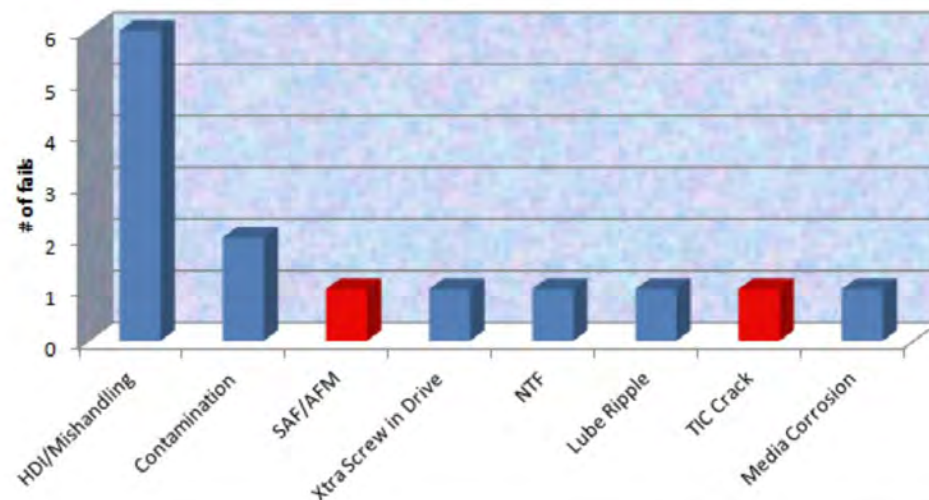
Grenada CI Component Level FAR
of Fails vs Type (Aug 12 - Feb 13)



Grenada ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)

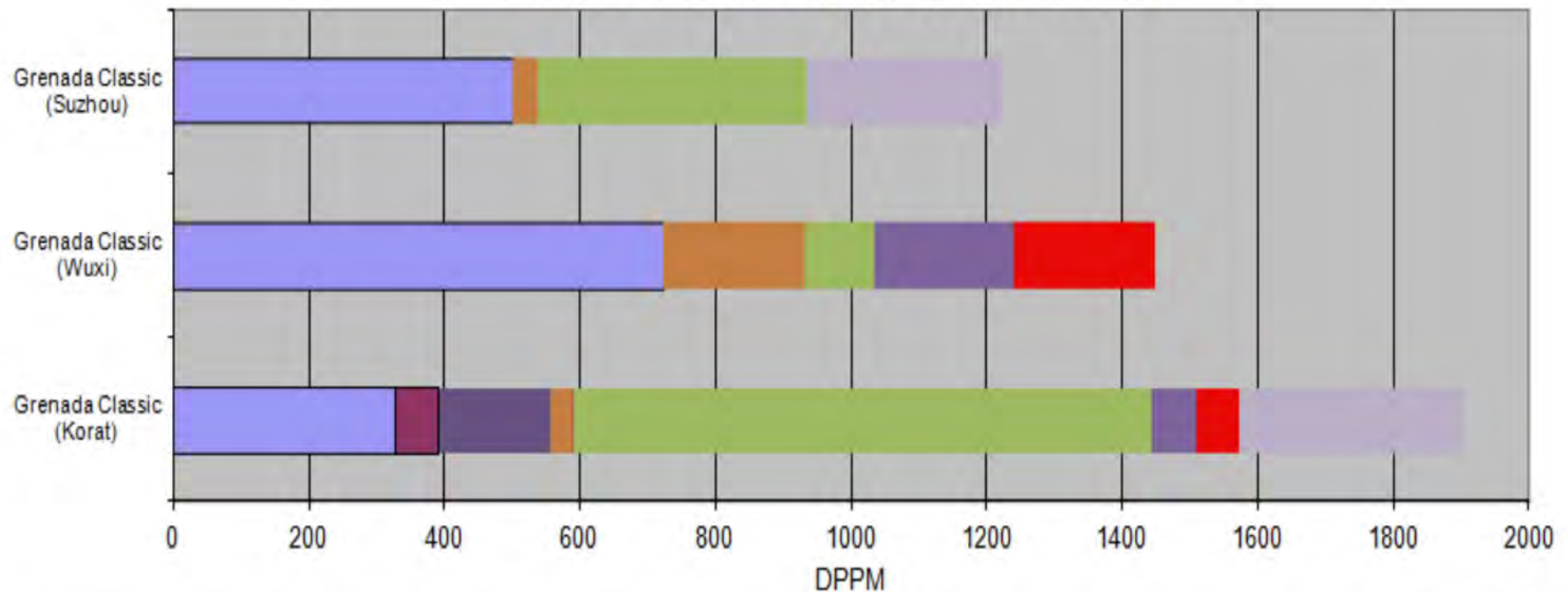


Grenada FR Component Level FAR
of Fails vs Type (Q113 - Q213)



Grenada Classic ODT Trends by Drive Build Site (DPPM)

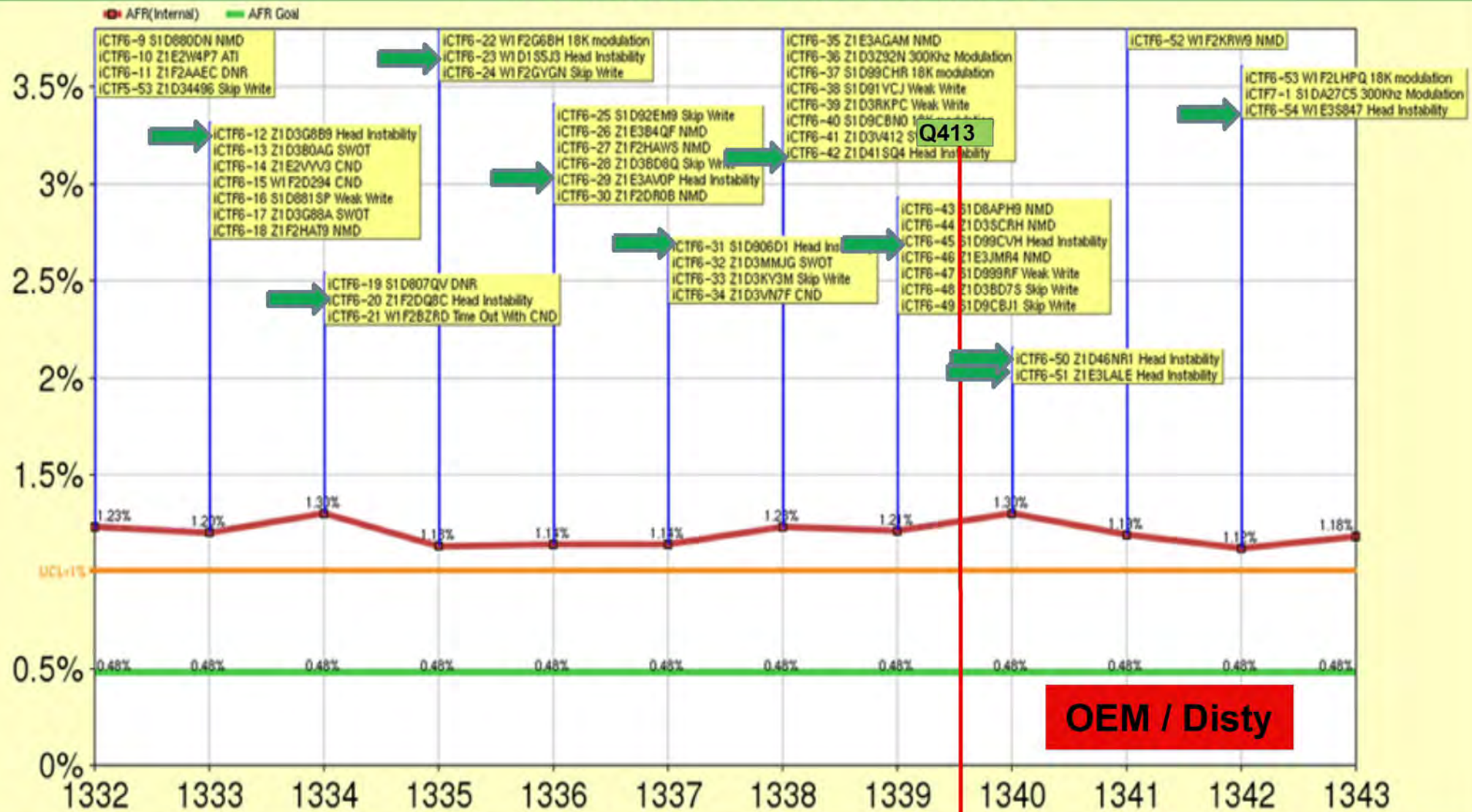
Grenada Classic ODT Pareto by Site - April 2013



Media Defects Offtrack/Abort Write PCBA FAIP MSD Erasure ATI/STE Skip/Weak Write DNR Resonance SWOT Head Related Drive Code Soft Error Modulation Other (Other)

Grenada Classic ORT (OEM / Disty) – Q413 (203K MTBF)

Grenada SS ORT Internal AFR Trend



HIGHLY CONFIDENTIAL

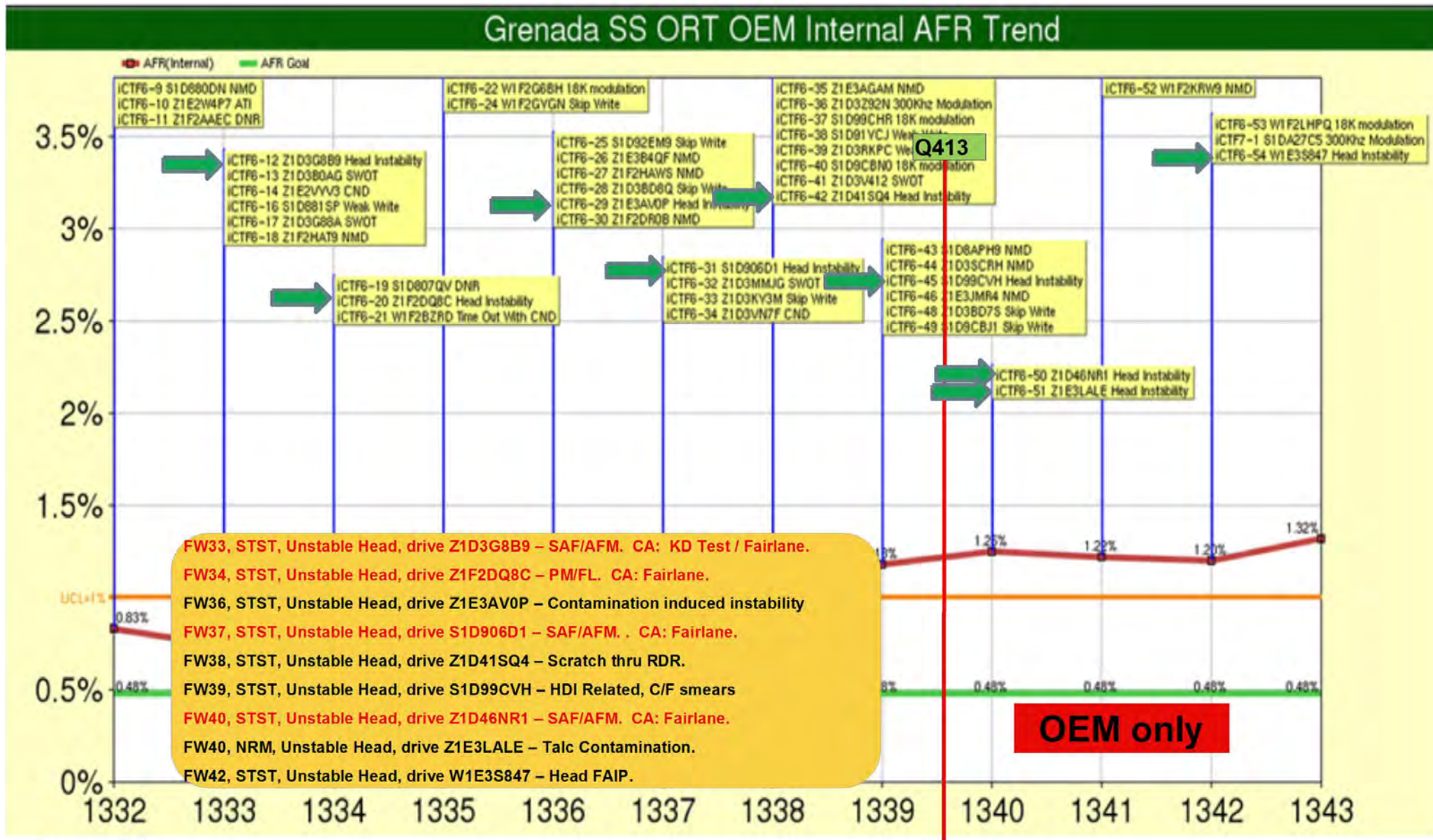
Seagate Confidential

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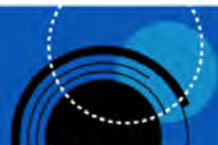
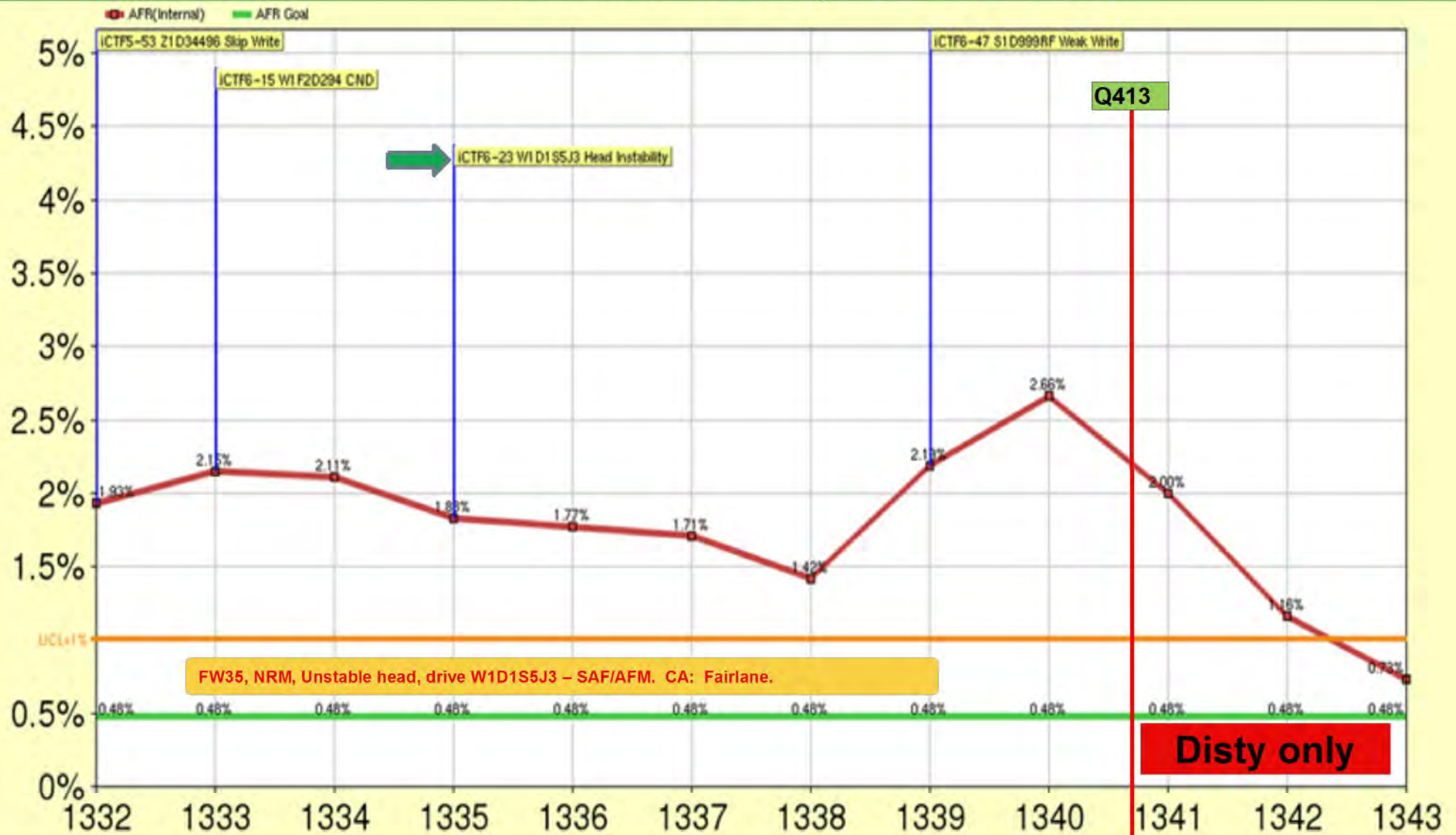
FED_SEAG0056593

Grenada Classic ORT (OEM) – Q413 (181K MTBF)

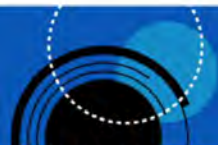
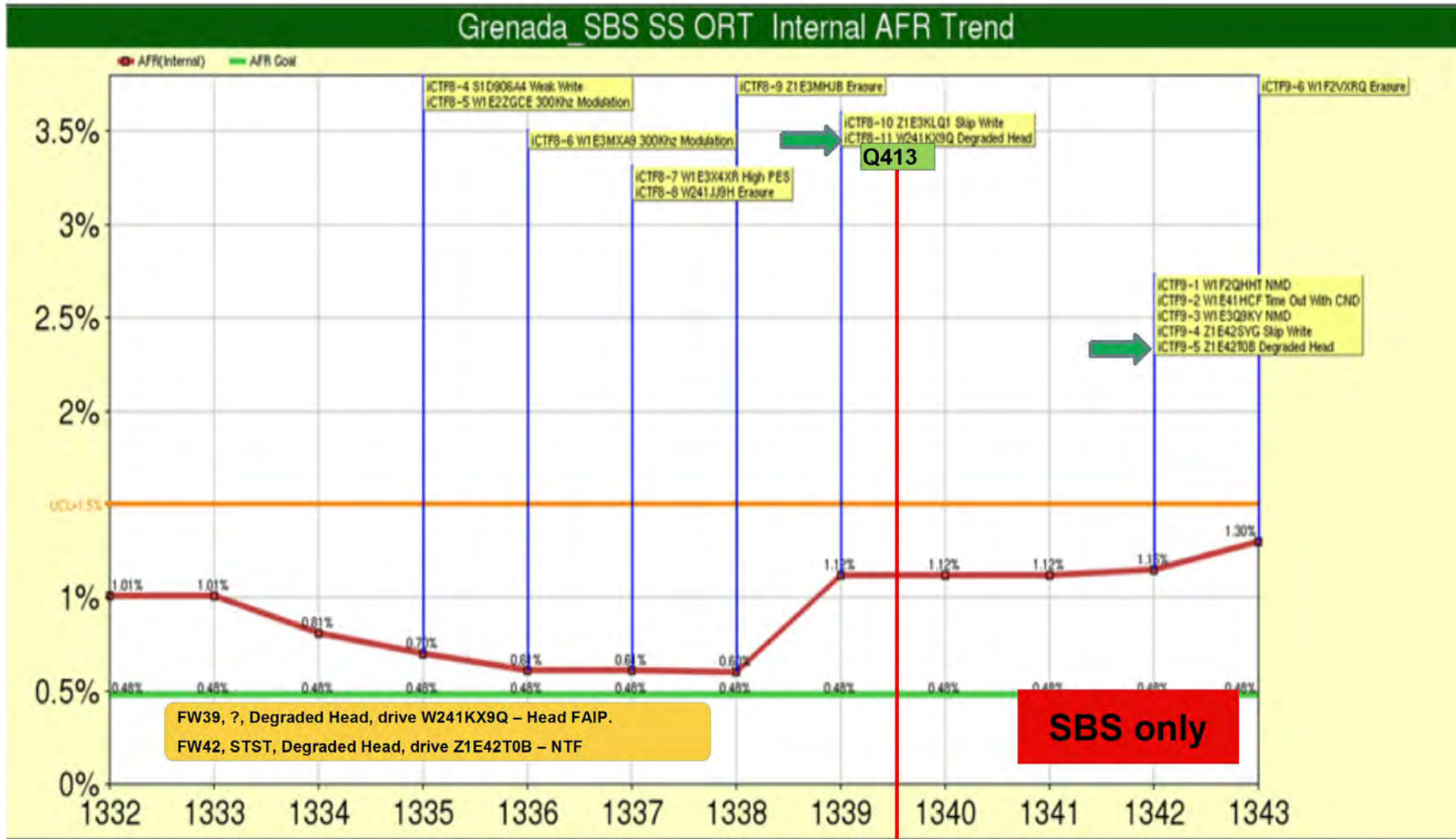


Grenada Classic ORT (Disty) – Q413 (328K MTBF)

Grenada SS ORT Disty Internal AFR Trend



Grenada Classic ORT (SBS) – Q413 (57K MTBF)



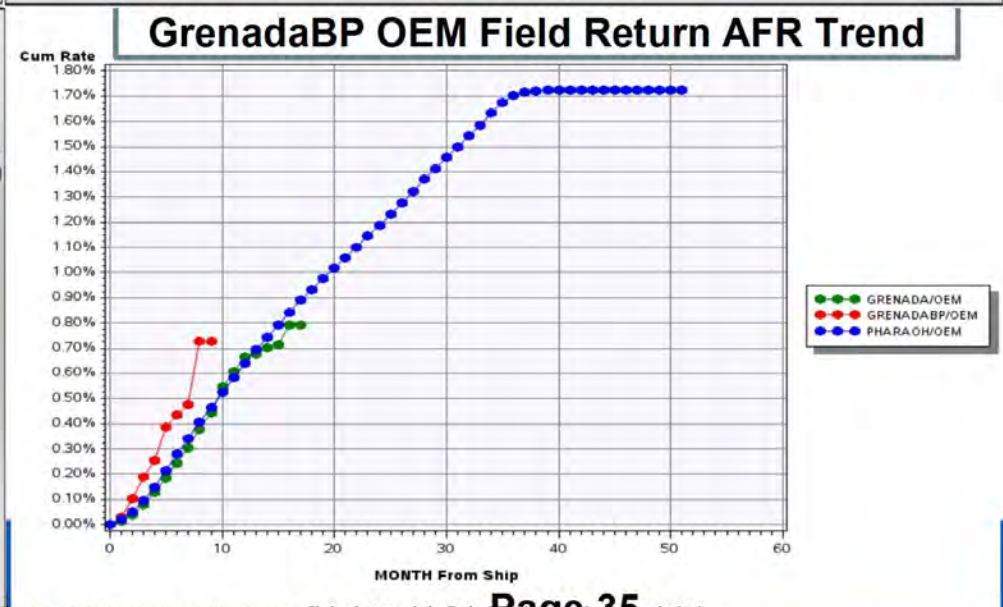
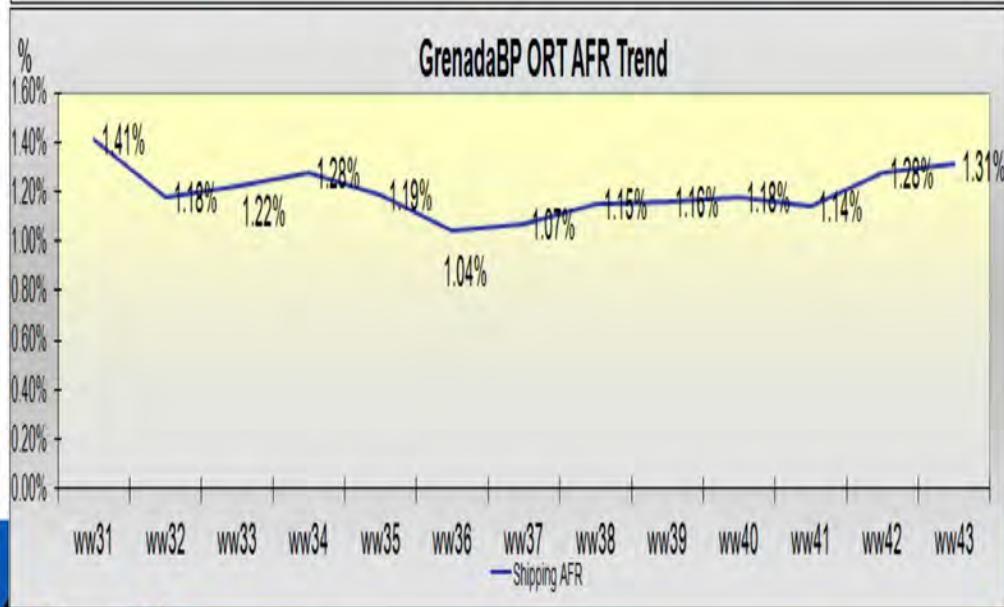
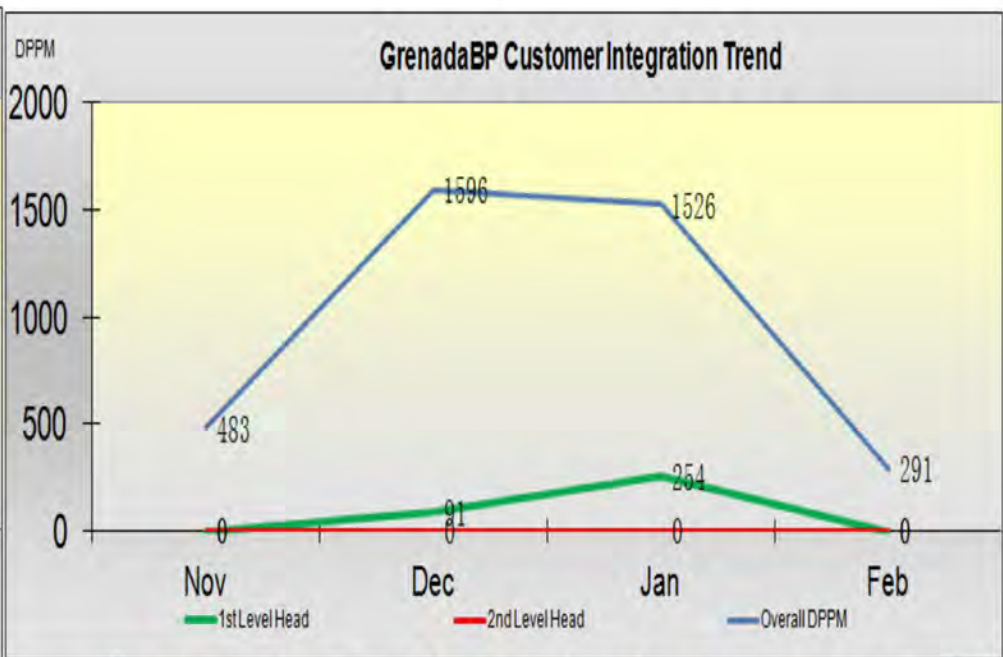
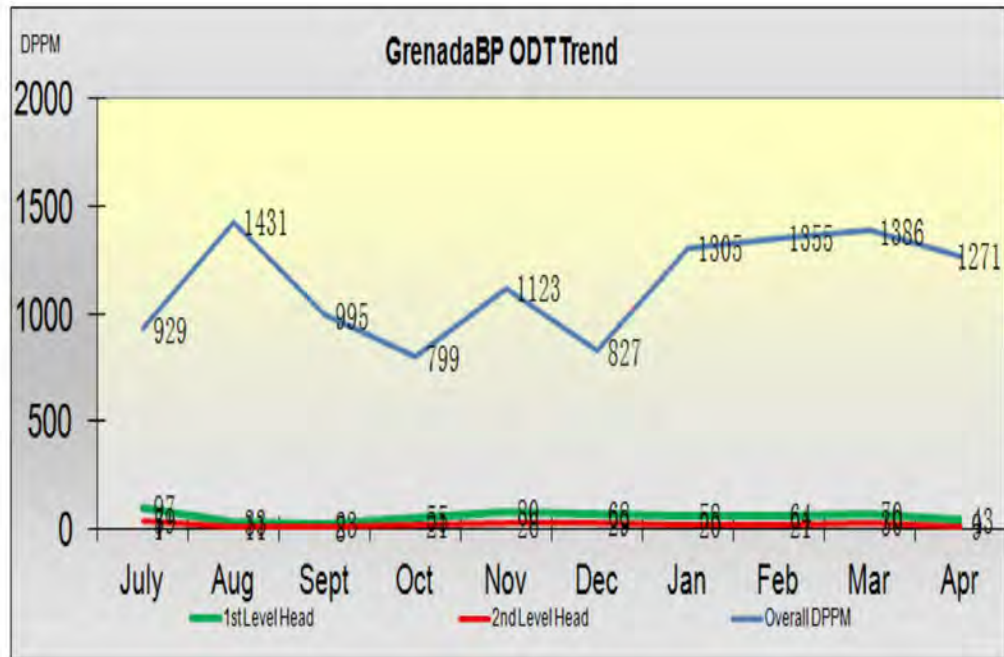
HIGHLY CONFIDENTIAL

Seagate Confidential

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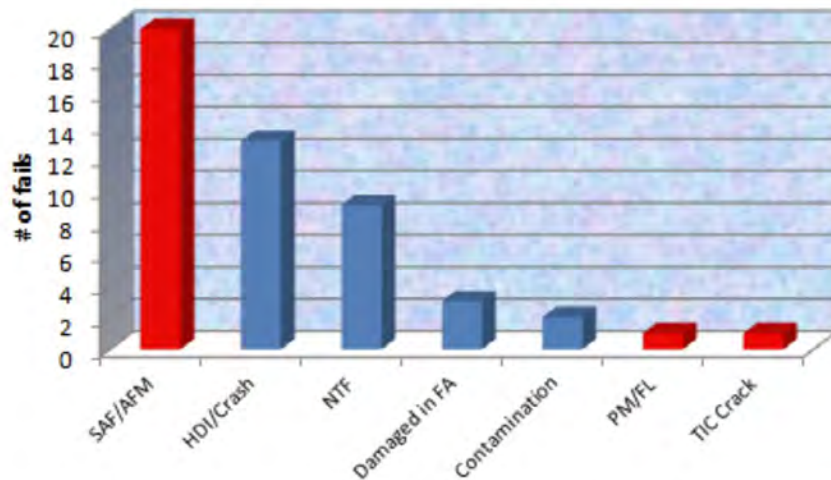
FED_SEAG0056596



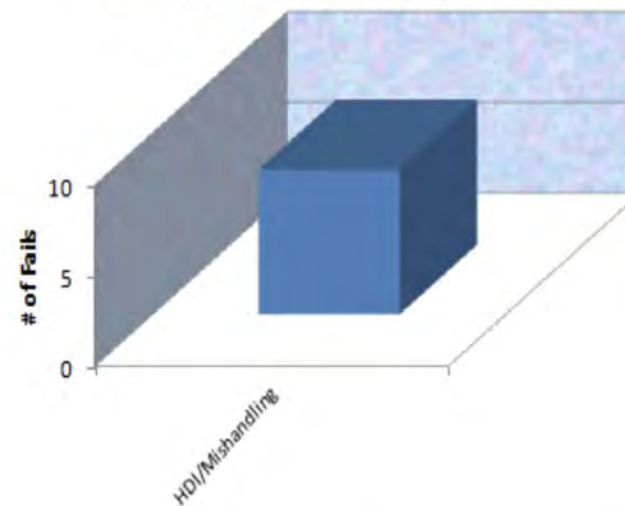
GrenadaBP Head Level Paretos (DPPM)

Validated via FACTS

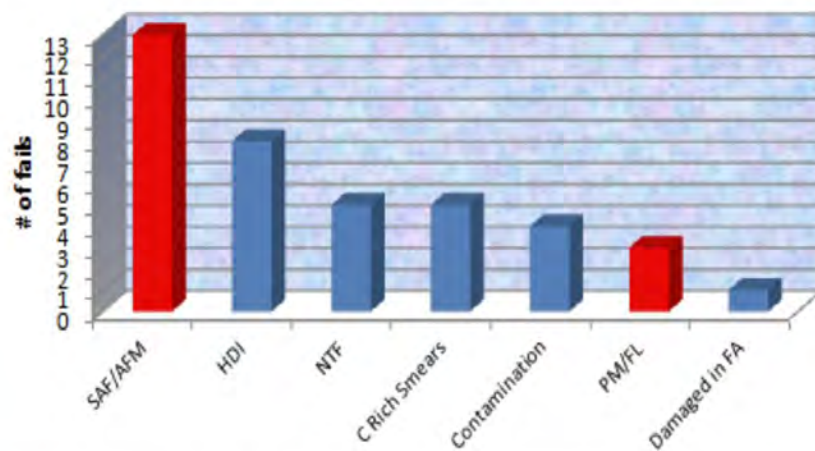
GrenadaBP ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



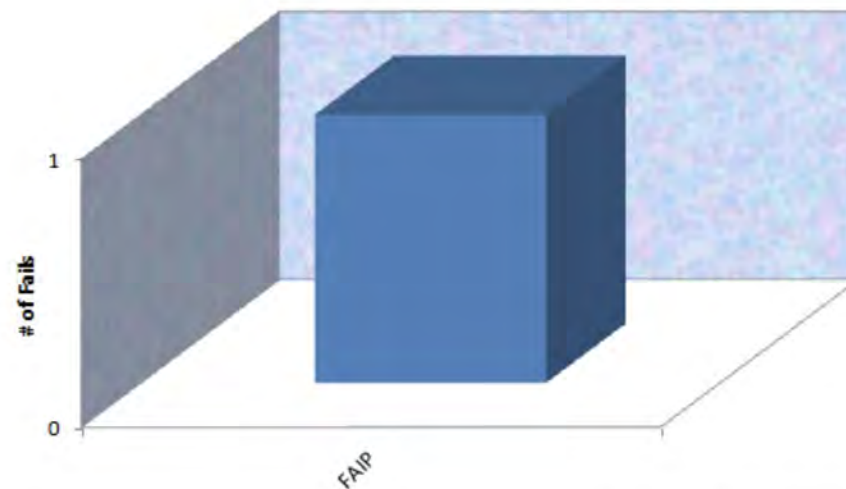
GrenadaBP CI Component Level FAR
of Fails vs Type (Nov 12 - Feb 13)



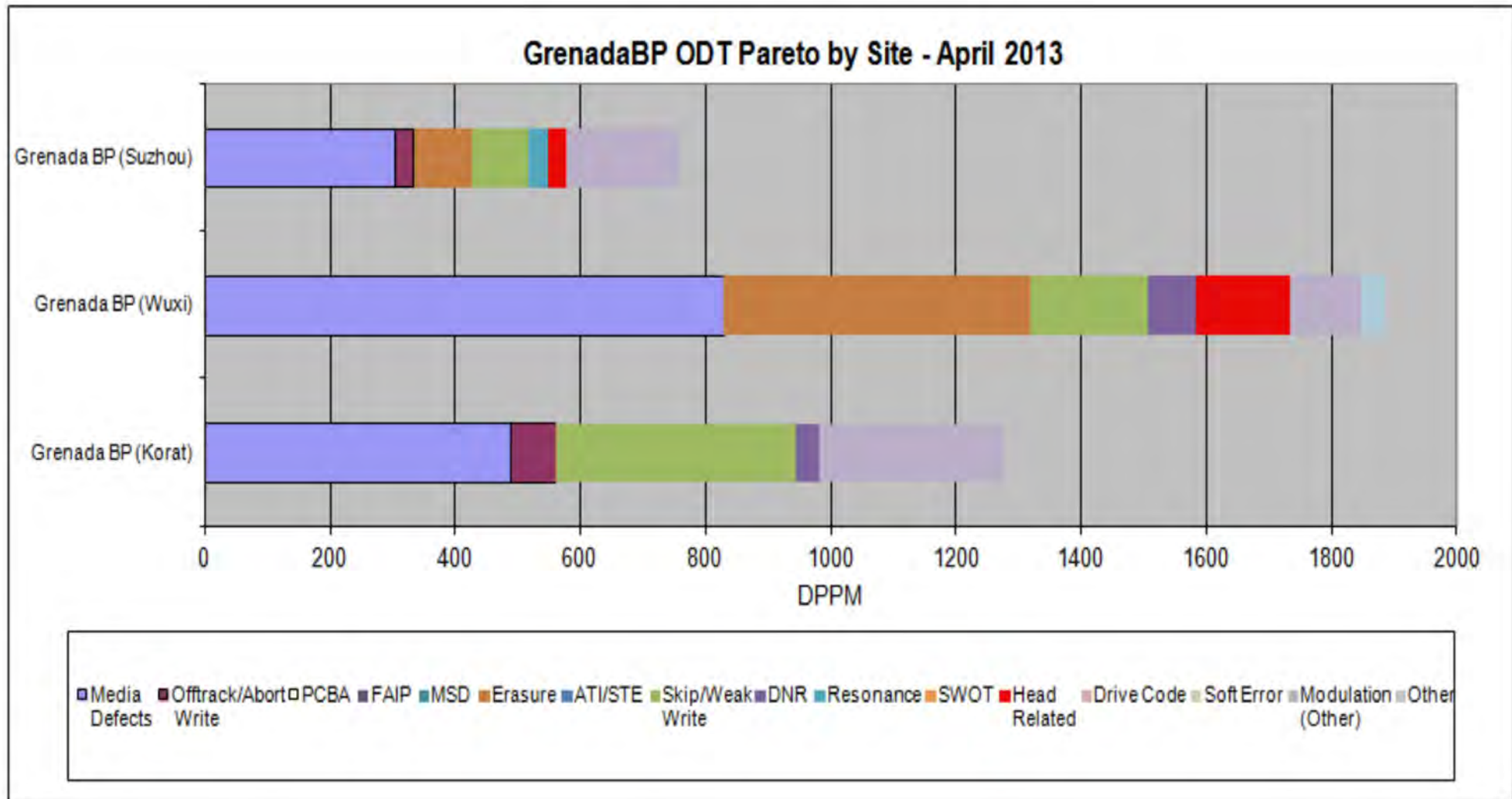
GrenadaBP ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



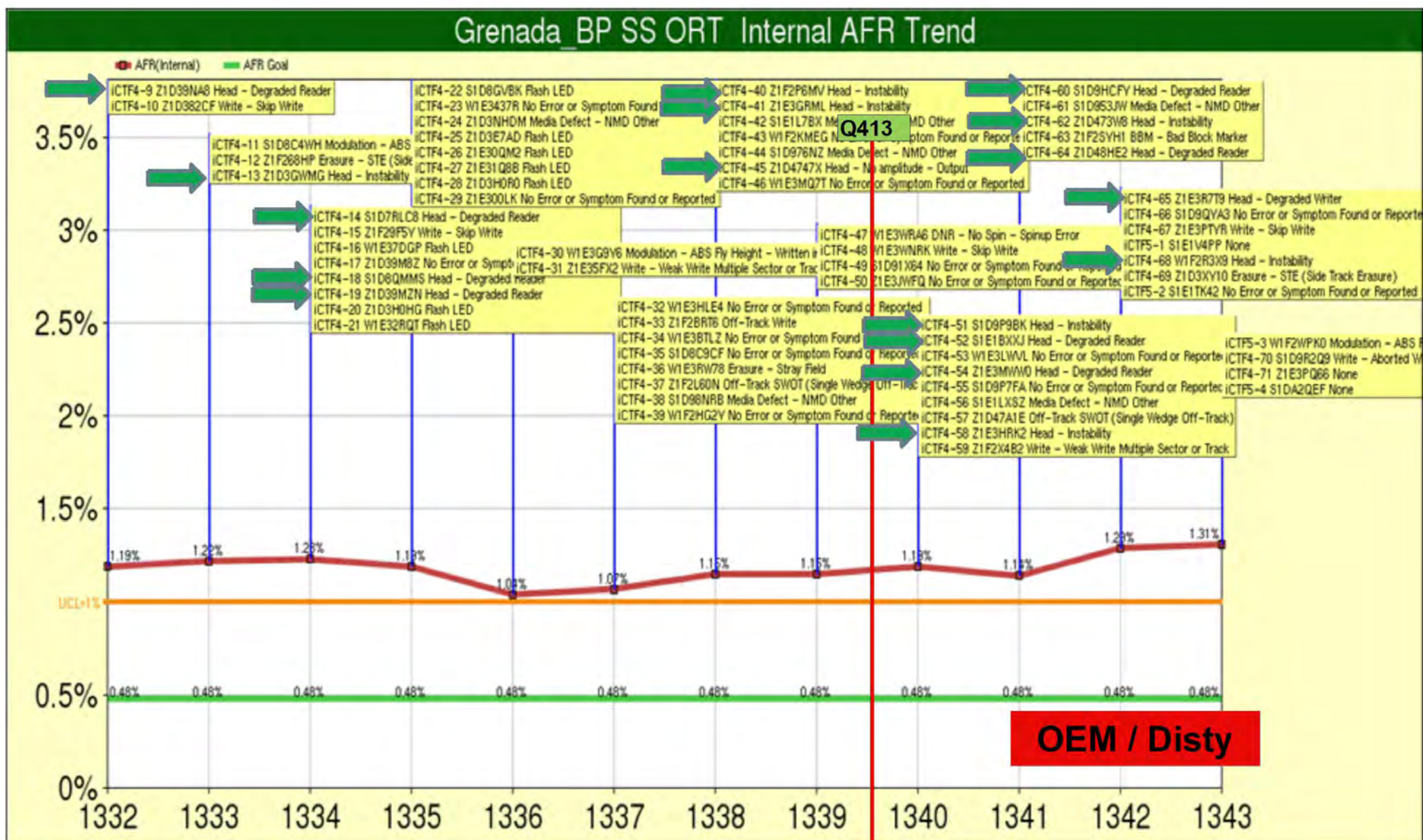
GrenadaBP FR Component Level FAR
of Fails vs Type (Q213)



GrenadaBP ODT Trends by Drive Build Site (DPPM)



Grenada BP ORT (OEM / Disty) – Q413 (181K MTBF)



HIGHLY CONFIDENTIAL

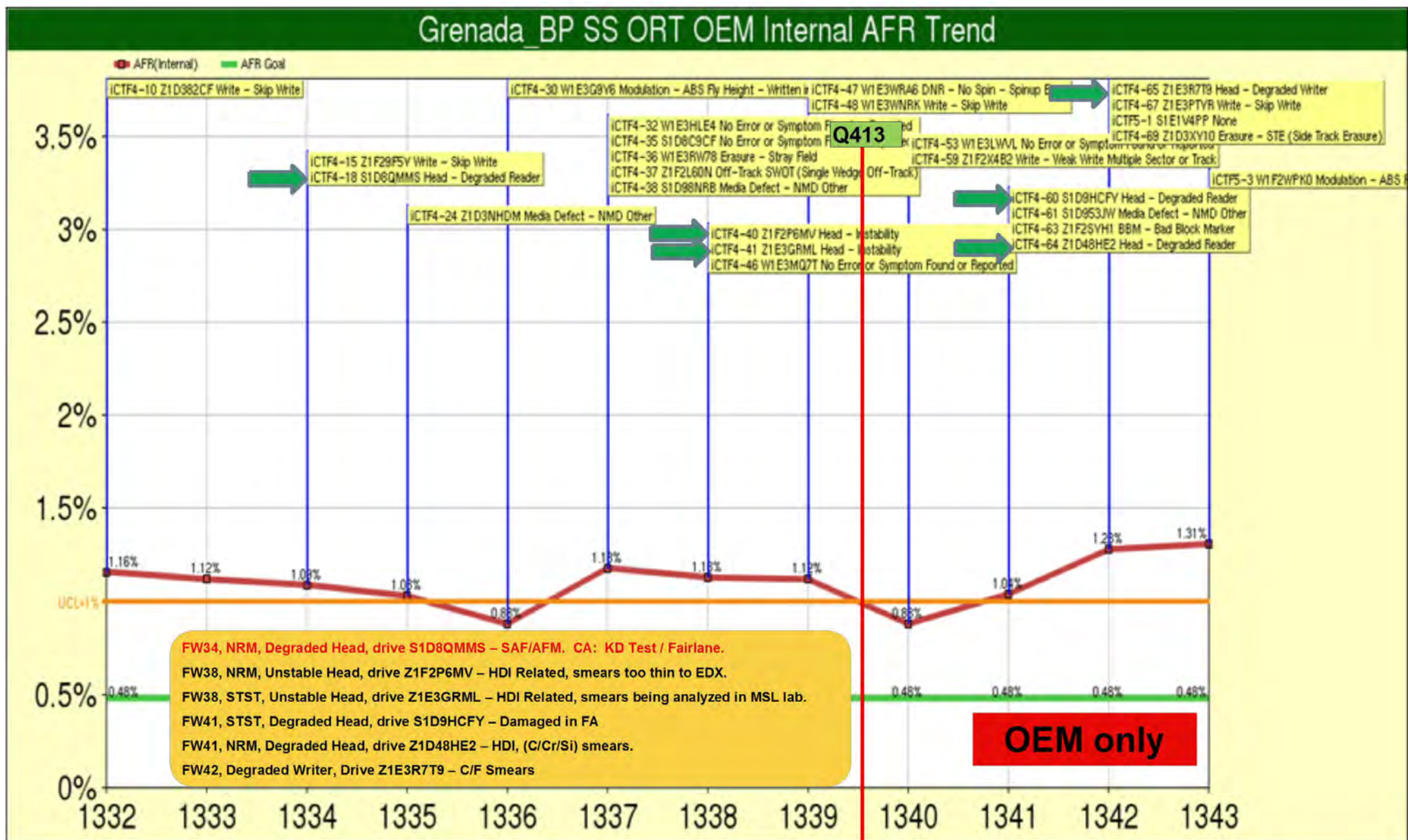
Seagate Confidential

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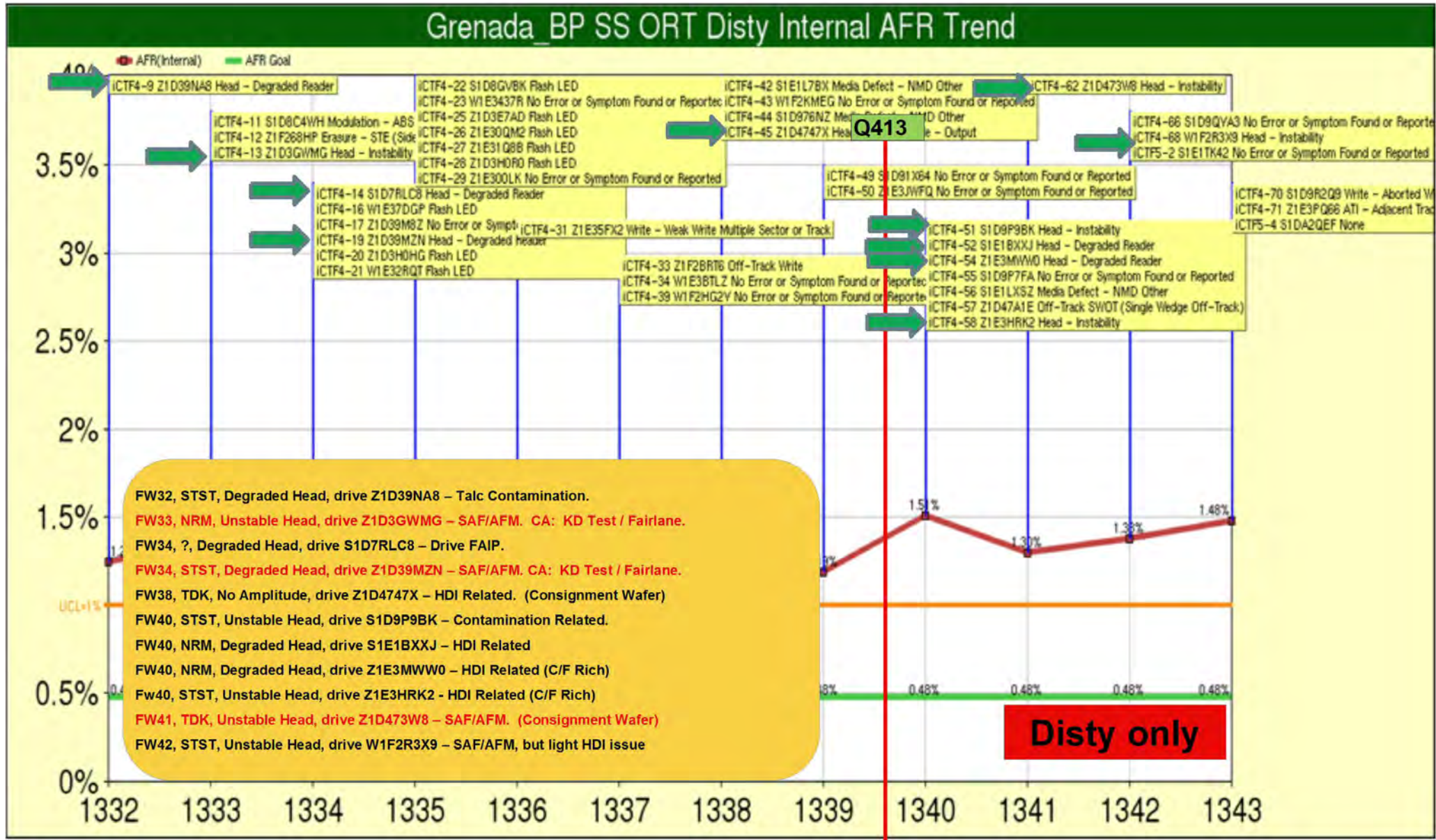


FED_SEAG0056600

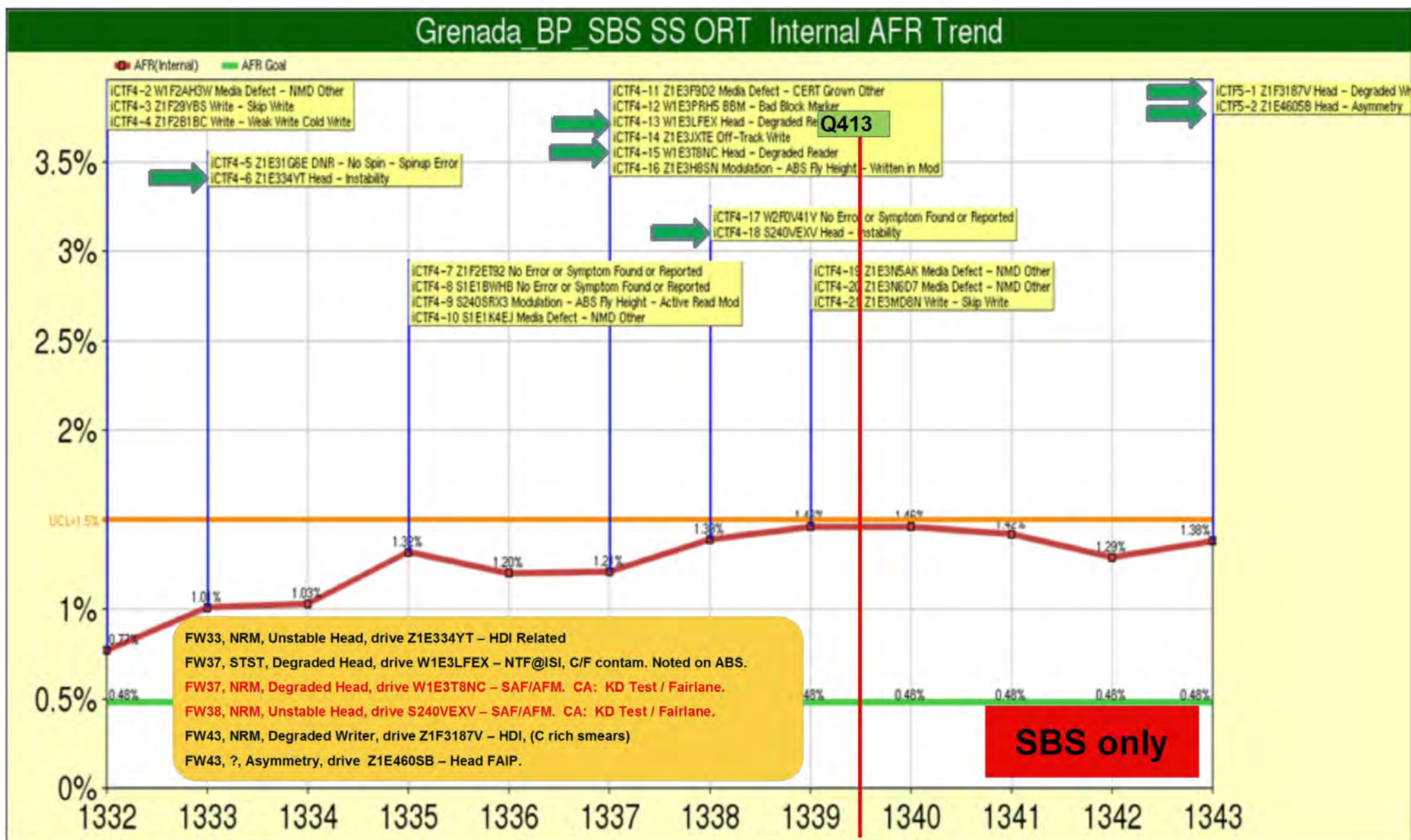
Grenada BP ORT (OEM) – Q413



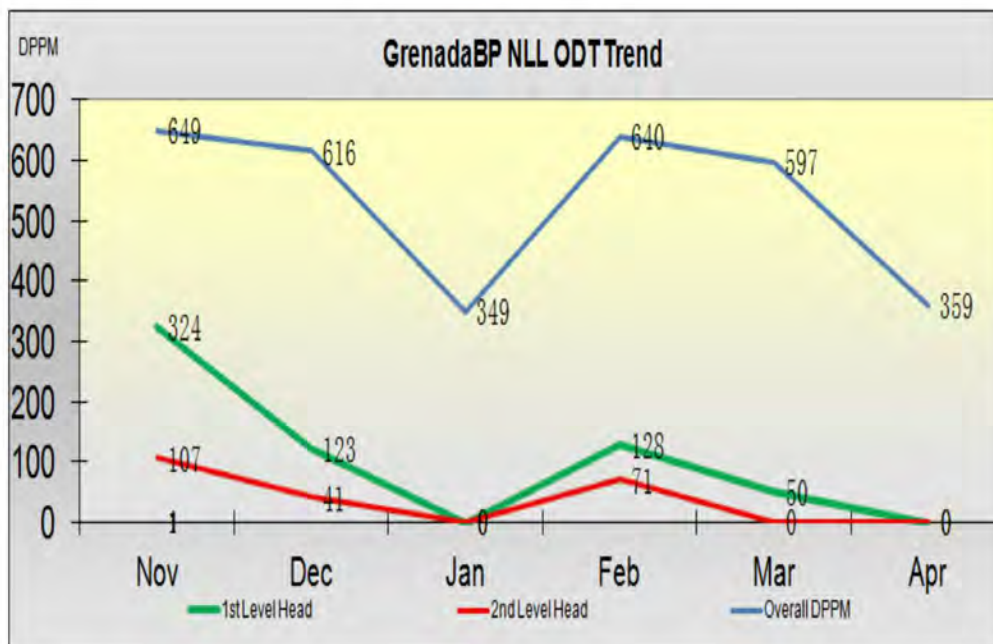
Grenada BP ORT (Disty) – Q413



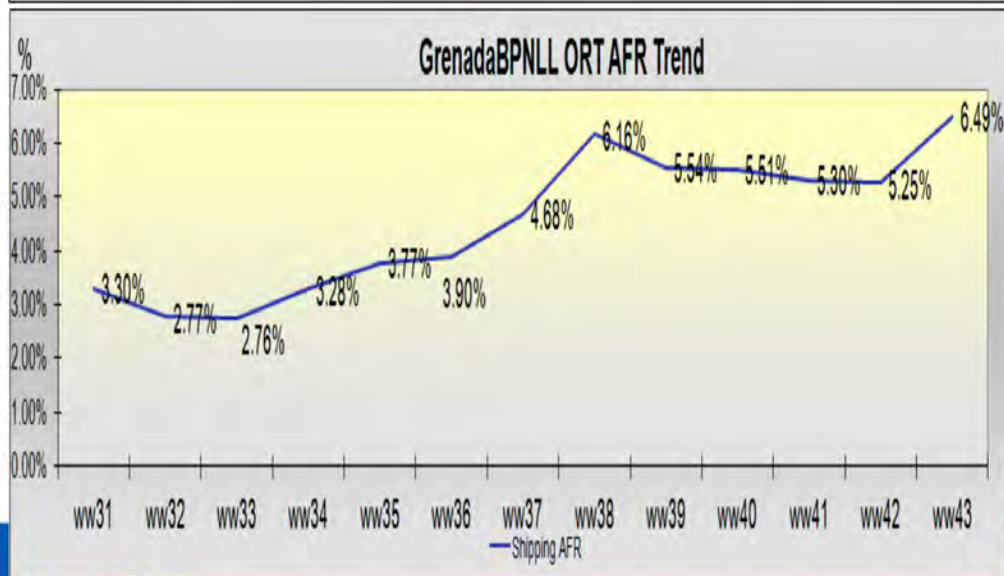
Grenada BP SBS ORT – Q413 (54K MTBF)



GrenadaBP NLL 1st/2nd Level Drive Trends (DPPM)



**No Customer Integration
Data
Available Yet**

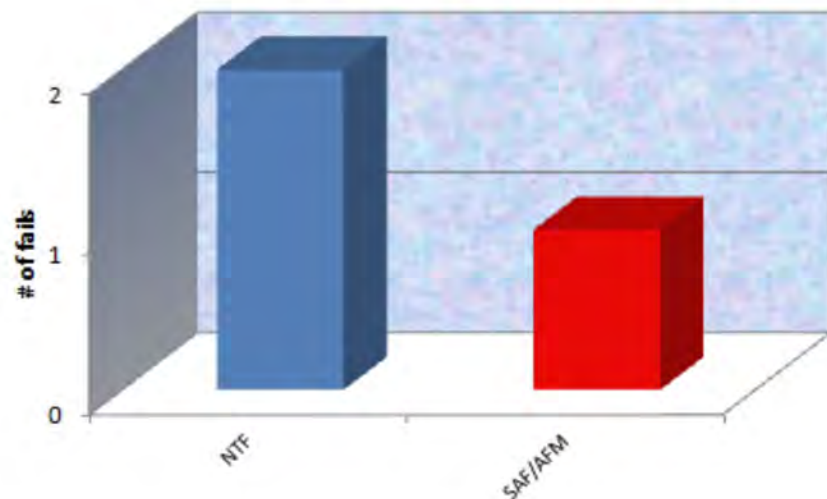


GrenadaNLL OEM Field Return AFR Trend

**No Field Return Data
Available Yet**

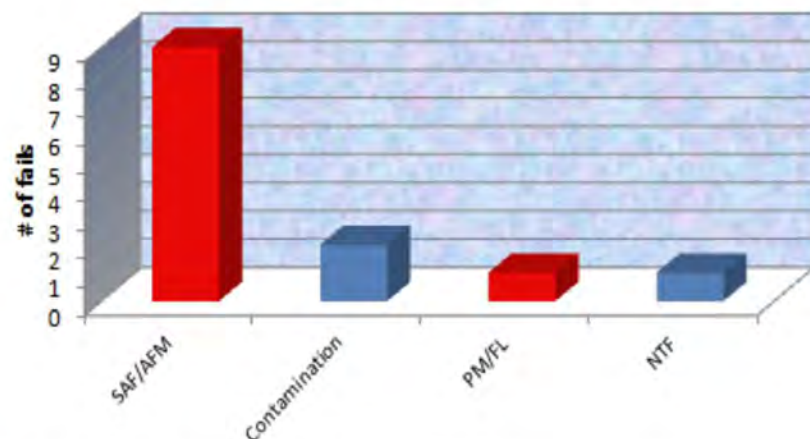
GrenadaBP NLL Head Level Pareto (DPPM) Validated via FACTS

**GrenadaBP NLL ODT Component Level FAR
of Fails vs Type (Nov 12 - Apr 13)**



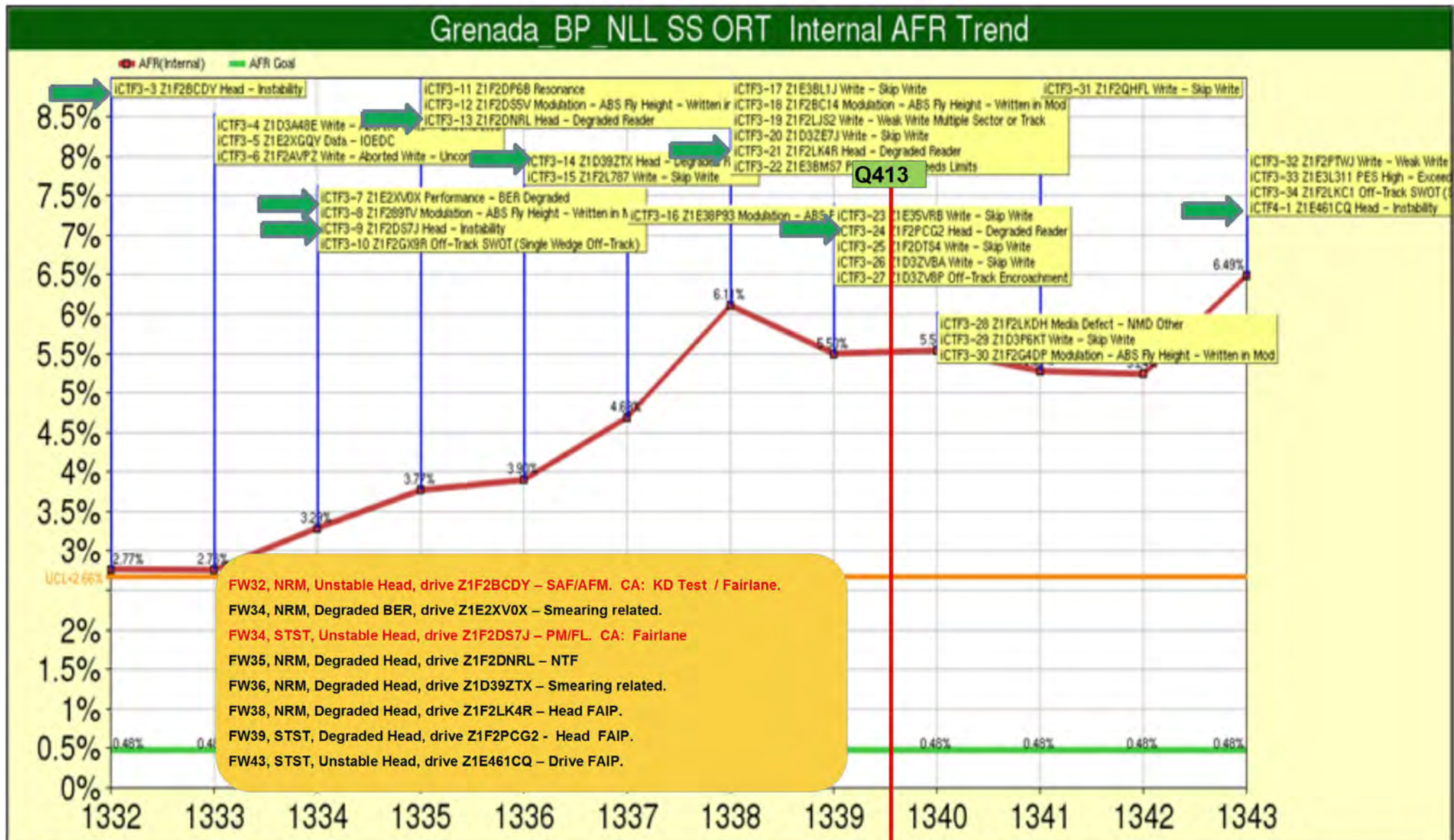
**No Customer Integration
Data
Available Yet**

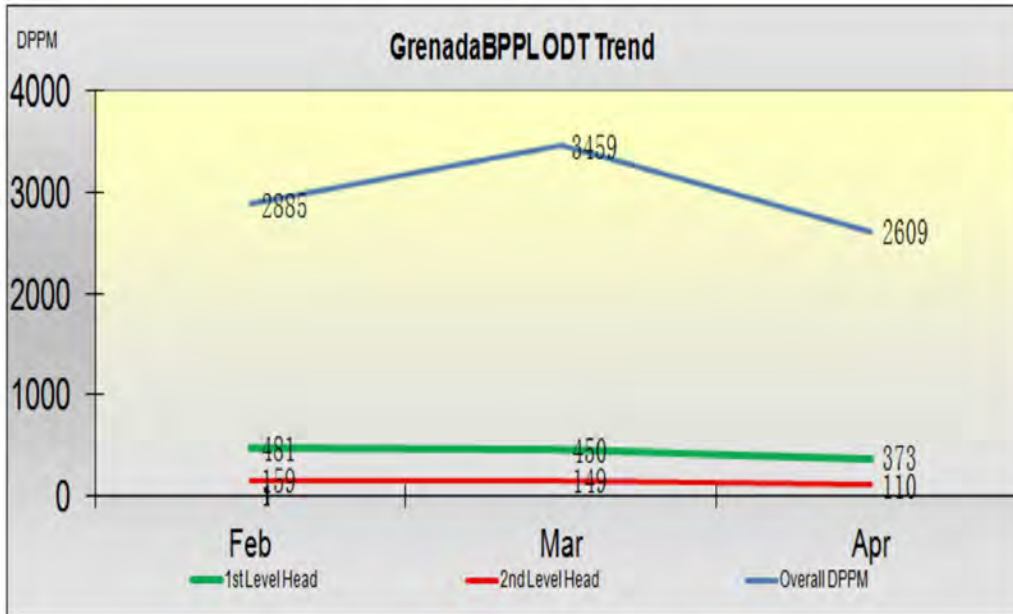
**GrenadaBP NLL ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)**



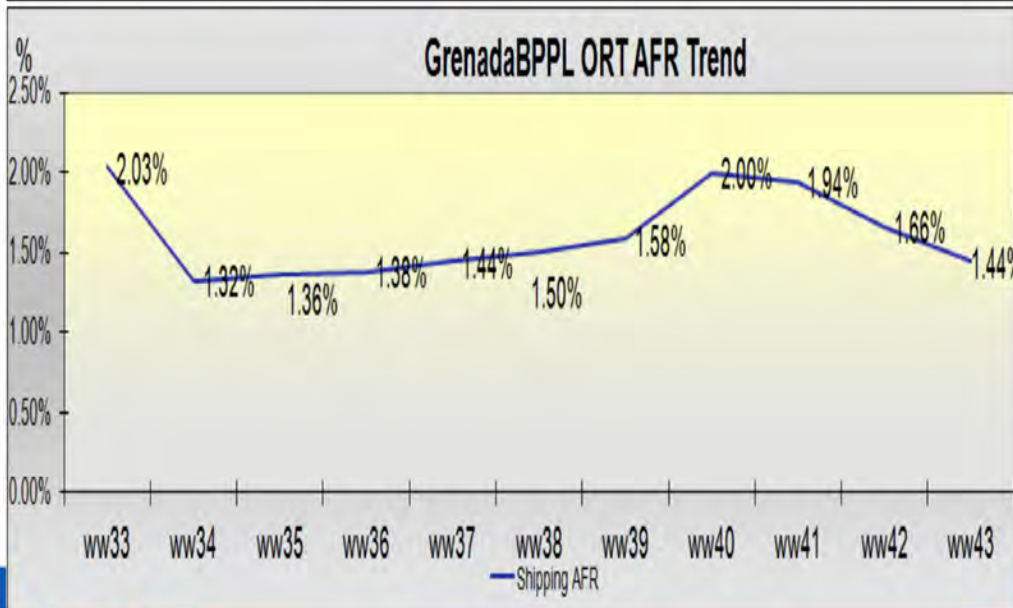
**No Field Return Data
Available Yet**

GrenadaBP NLL ORT – Q413





No Customer Integration Data Available Yet



GrenadaBPPL OEM Field Return AFR Trend

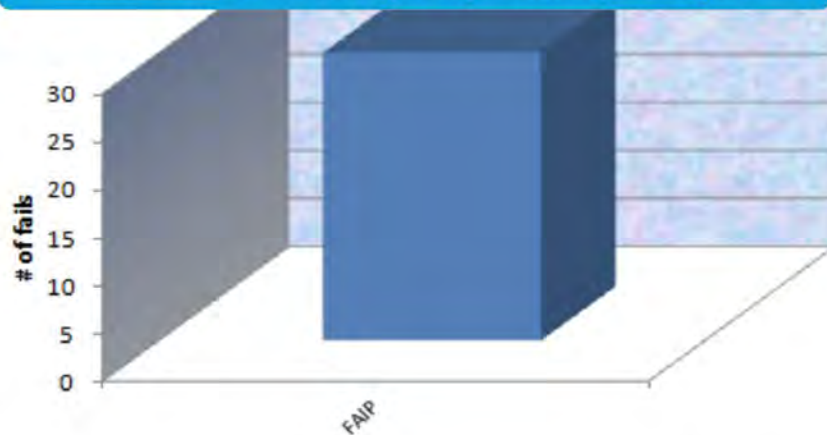
No Field Return Data Available Yet

GrenadaBPPL Head Level Paretos (DPPM)

Validated via FACTS

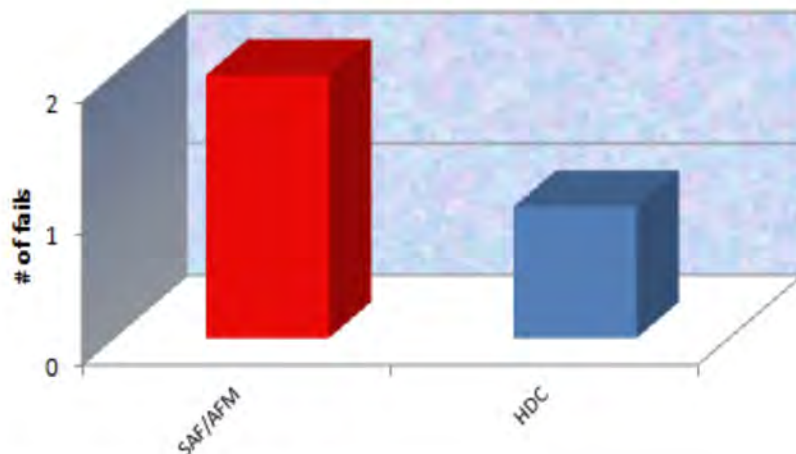
GrenadaBPPL ODT Component Level FAR
of Fails vs Type (Feb 13 - Apr 13)

All GrenadaBPP ODT failures for past three months not getting head level FA due to low priority according to Jerayot.



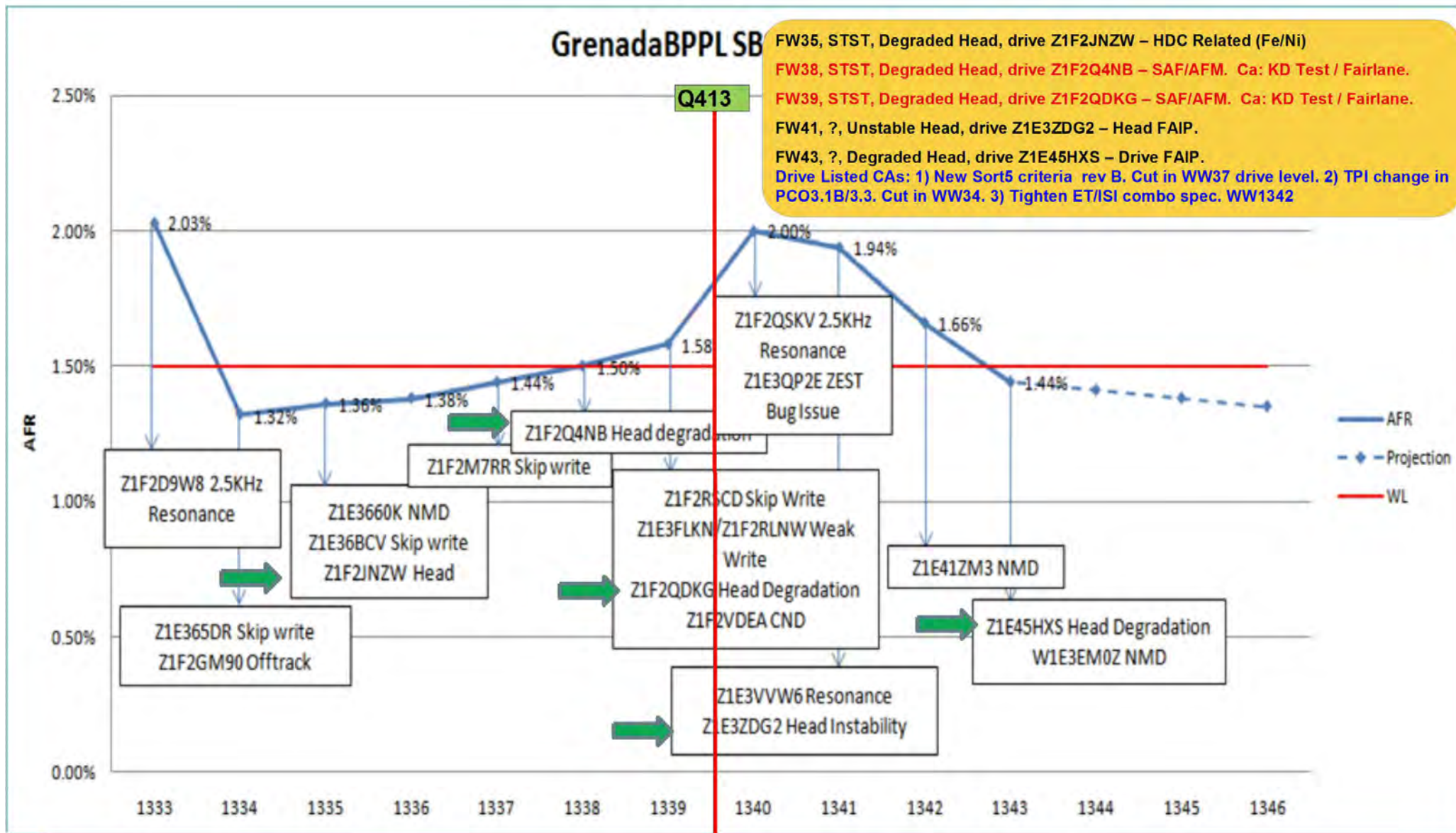
**No Customer Integration
Data
Available Yet**

GrenadaBPPL ORT Component Level FAR
of Fails vs Type (Feb 13 - Apr 13)

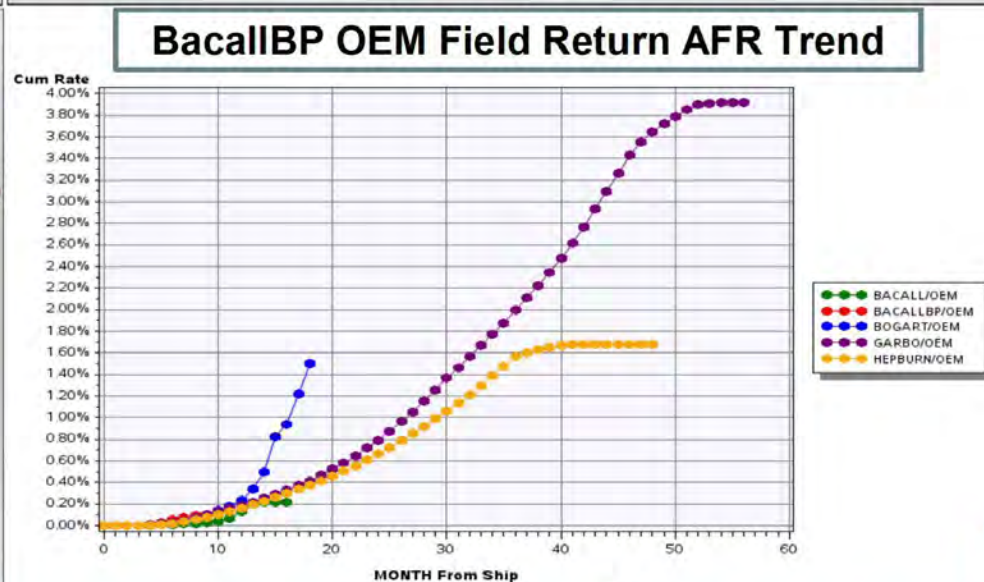
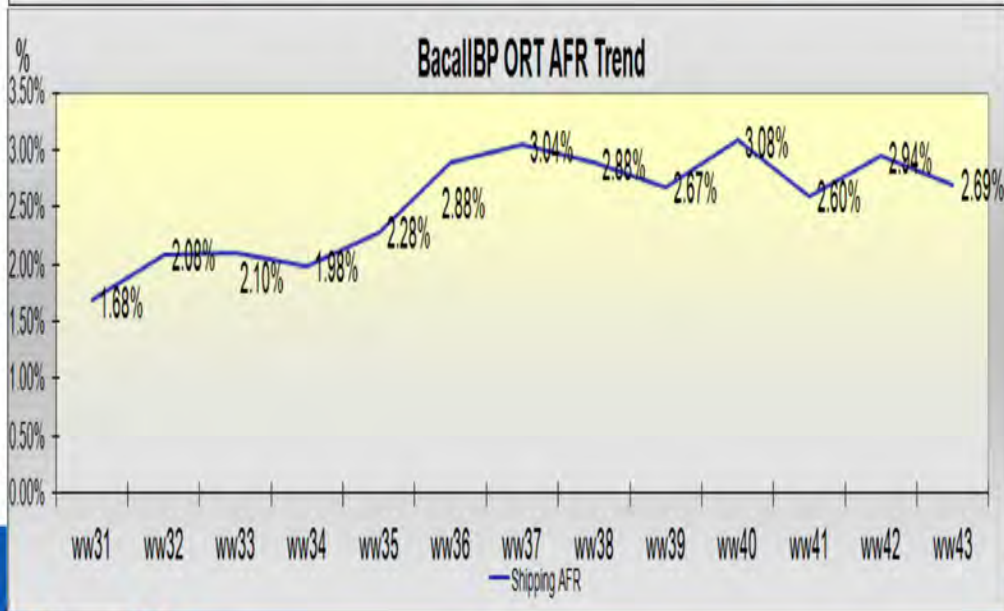
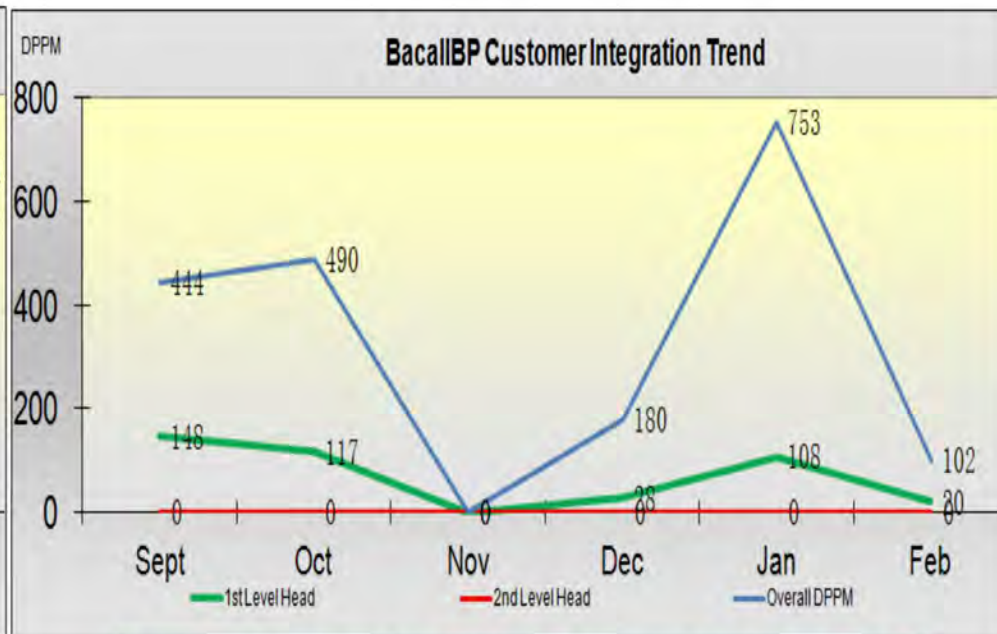
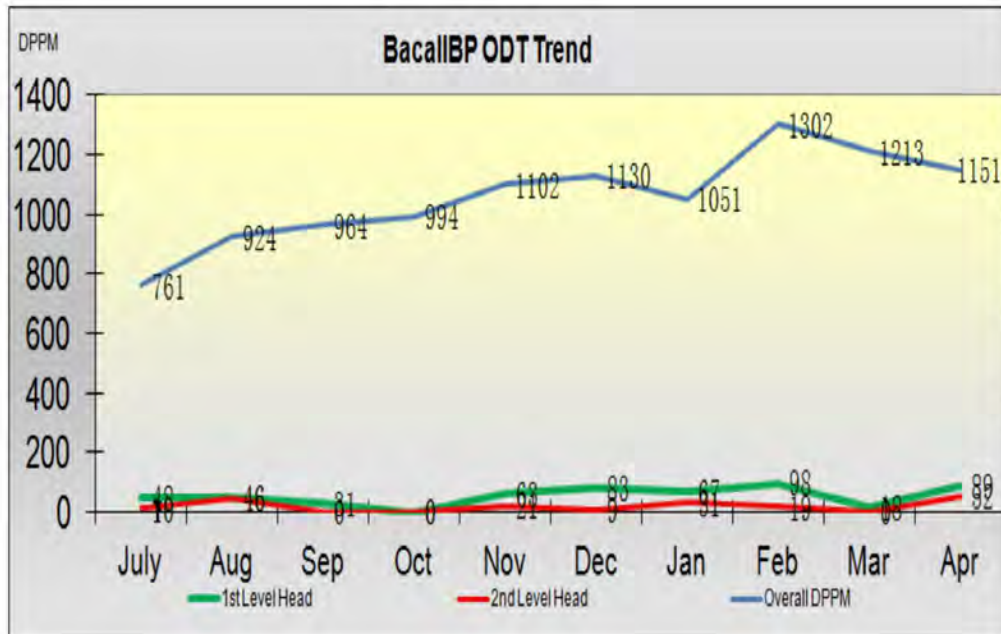


**No Field Return Data
Available Yet**

GrenadaBPPL ORT – Q413



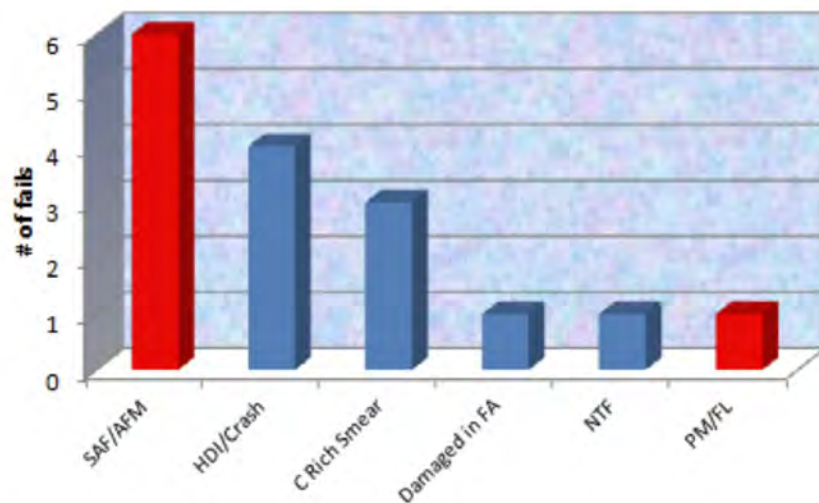
BacallBP 1st/2nd Level Drive Trends (DPPM)



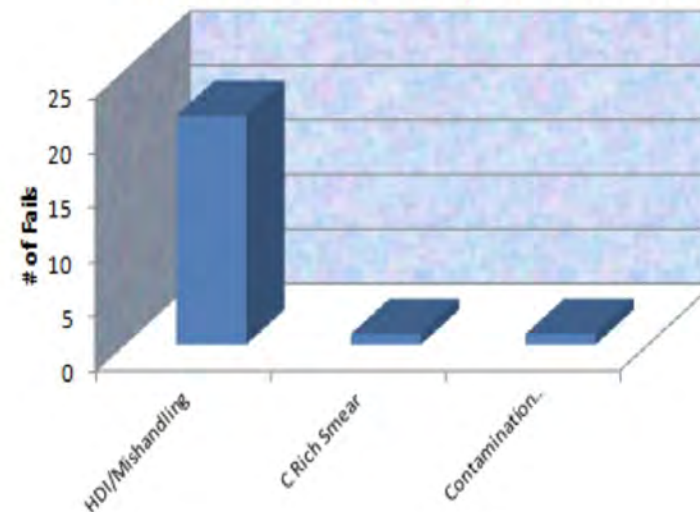
gCube F005274 Created: 03MAY13 16:22 Note: Incomplete Data Points have been excluded

BacallBP Head Level Pareto (DPPM) Validated via FACTS

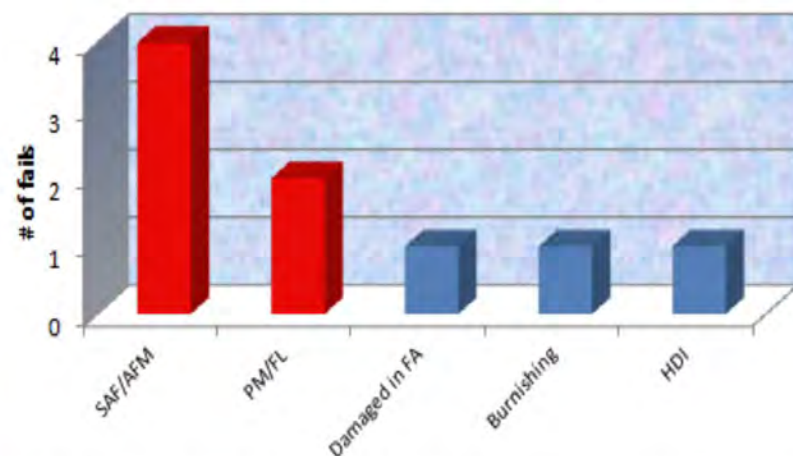
BacallBP ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



BacallBP CI Component Level FAR
of Fails vs Type (Sept 12 - Feb 13)

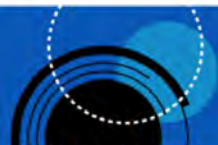
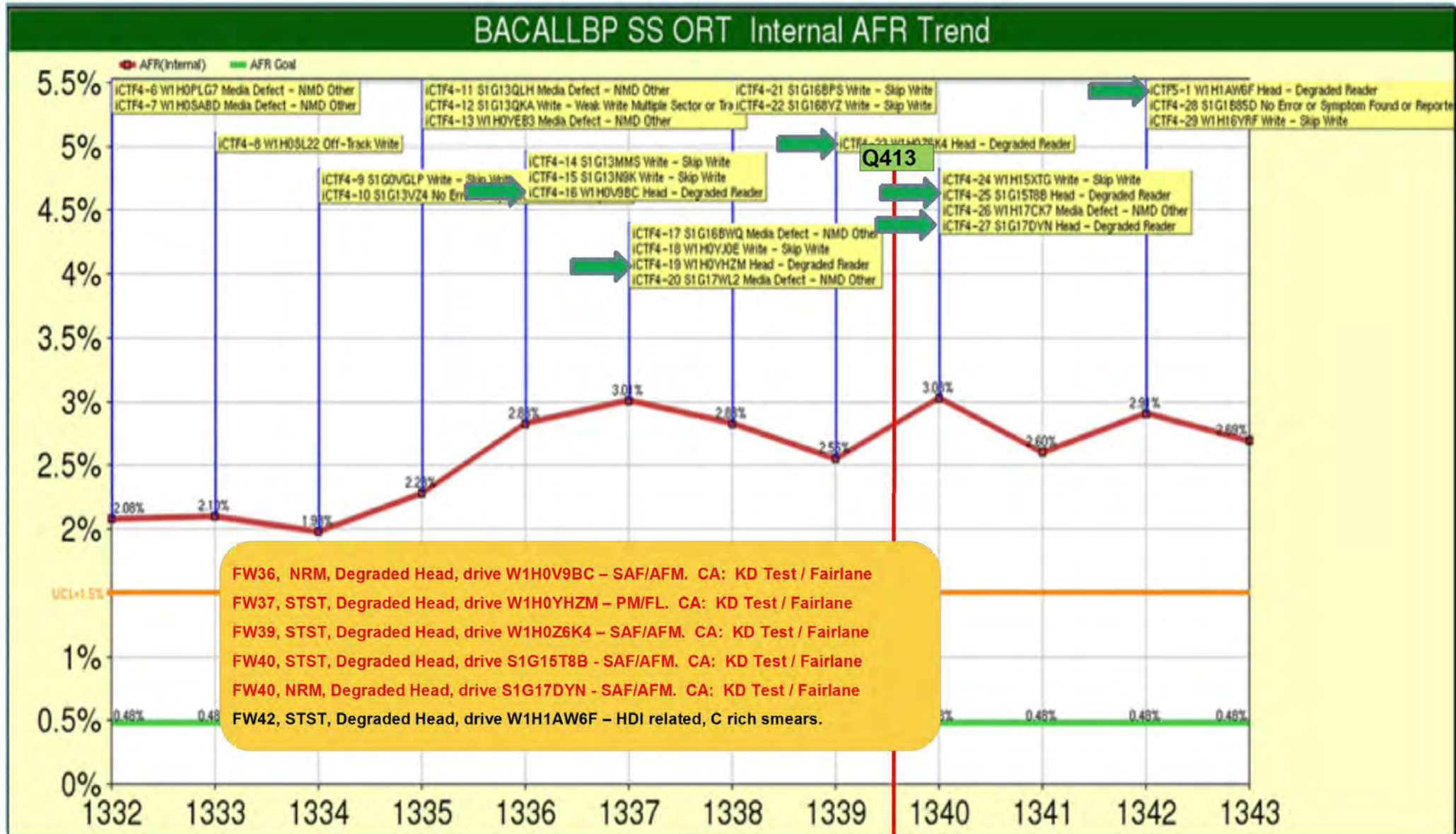


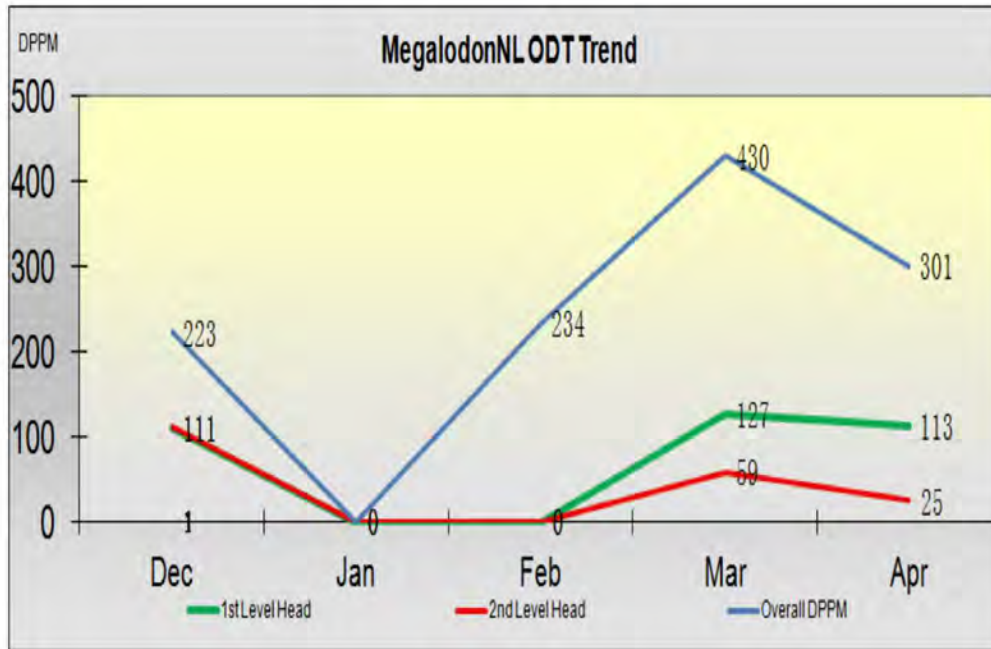
BacallBP ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



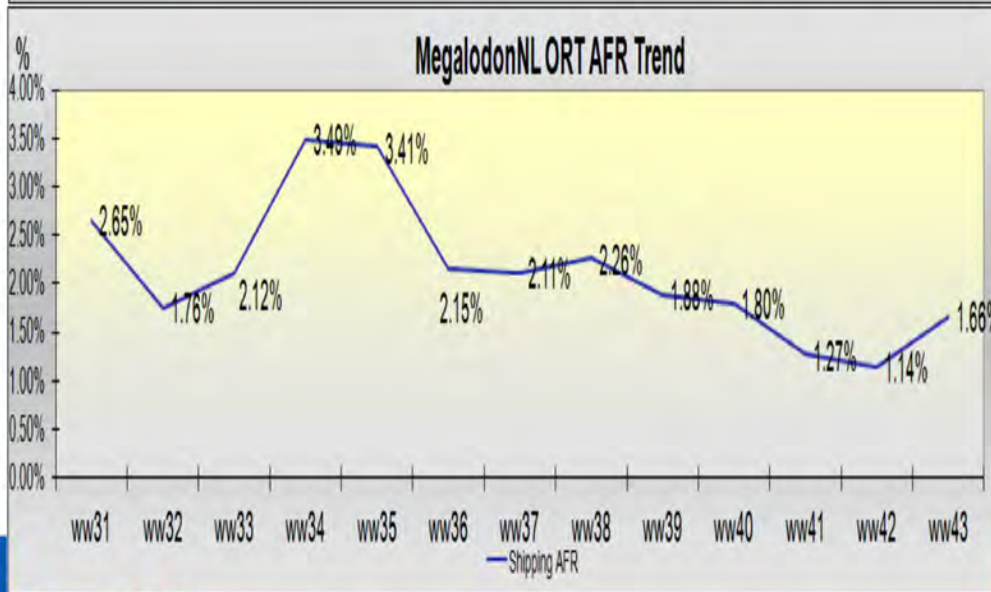
**No Field Return Data
Available Yet**

BacalIBP ORT MTBF – Q413 (322K MTBF)





No Customer Integration Data Available Yet

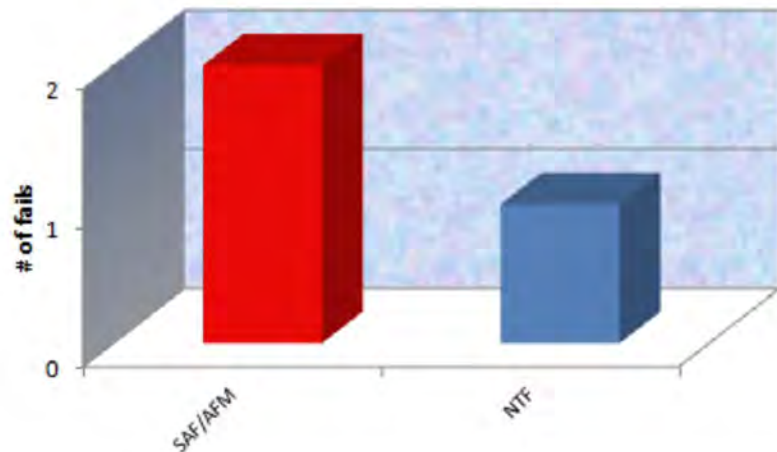


MegalodonNL OEM Field Return AFR Trend

No Field Return Data Available Yet

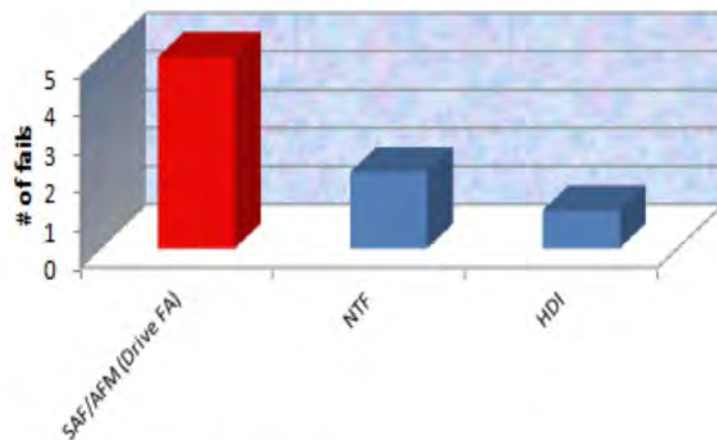
MegalodonNL Head Level Pareto (DPPM) Validated via FACTS

**MegalodonNL ODT Component Level FAR
of Fails vs Type (Dec 12 - Apr 13)**



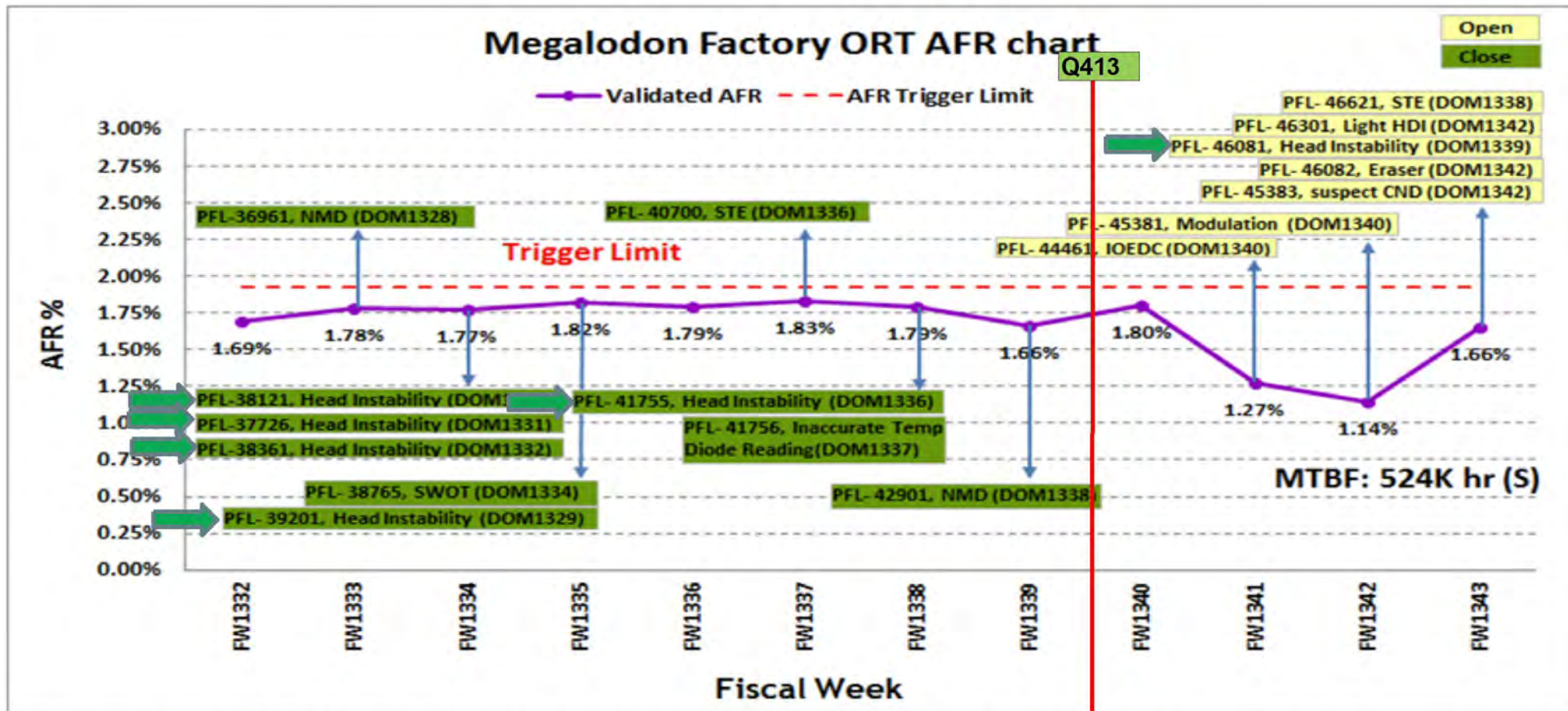
**No Customer Integration
Data
Available Yet**

**MegalodonNL ORT Component Level FAR
of Fails vs Type (Dec 12 - Apr 13)**



**No Field Return Data
Available Yet**

MegalodonNL ORT Q413 (524k MTBF)



Remark : The calculation of MTBF and AFR have been started since ww1330 onward.

FW34, Unstable Head, drive Z1Y01CNF – Drive FAIP.

FW34, Unstable Head, drive Z1W01DE8 – Can't validate drive issue (NTF), although can capture with new Chirp2 spec.

FW34, Unstable Head, drive Z1Z0BDN3 – RHO Head FAIP.

FW35, Unstable Head, drive Z1X01ET2 - Drive FAIP.

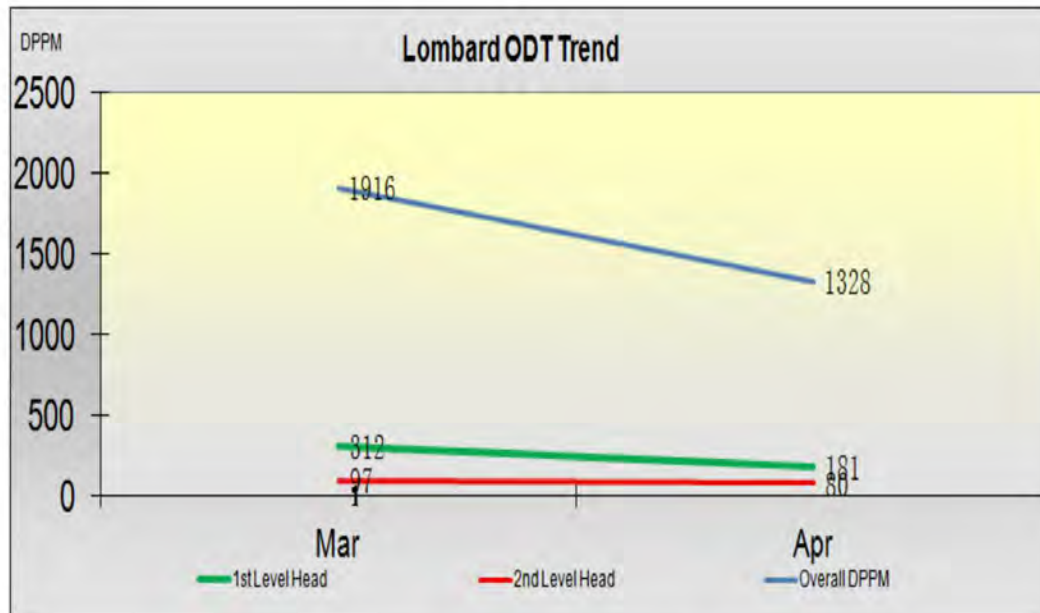
FW38, Unstable Head, drive Z1Z0DNBB – RHO Head FAIP.

FW43, Unstable Head, drive Z1Z0F04R – Drive FAIP.

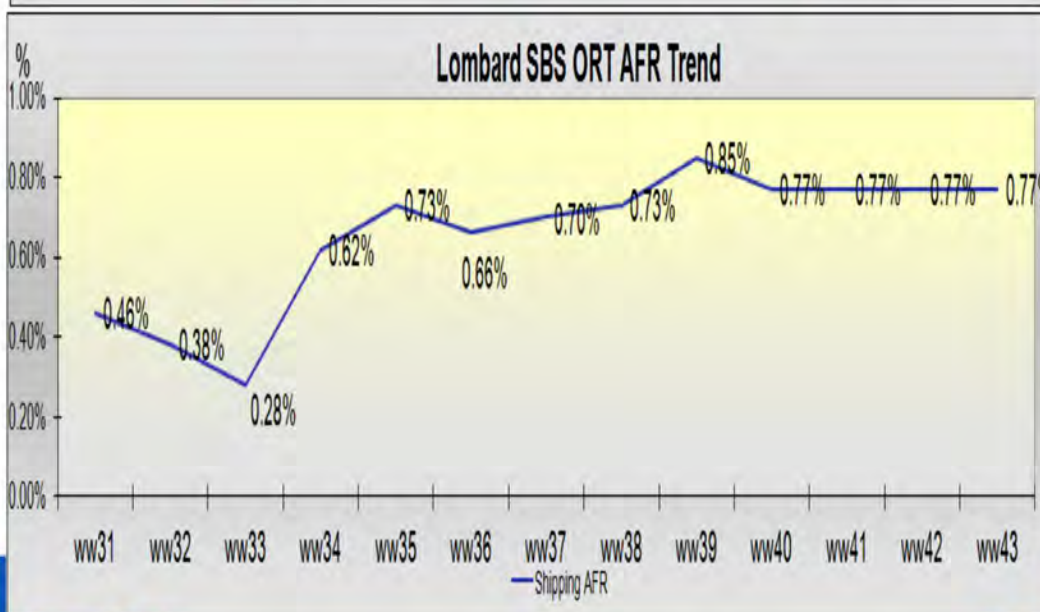
Drive listed CAs for above drives: Component level (Slider & HGSA): Tighten ISI combo at slider (ISI_AMP, SMAN_NORM, ASYM), Tighten ET combo at HGA (ET_AMP, ASYM, Baseline Noise), Implement ISI stress test at slider, HGA Rev 27A spec, Implement CHIRP2 spec

Sonklin Chudanklang

Lombard 1st/2nd Level Drive Trends (DPPM)



No Customer Integration Data Available Yet



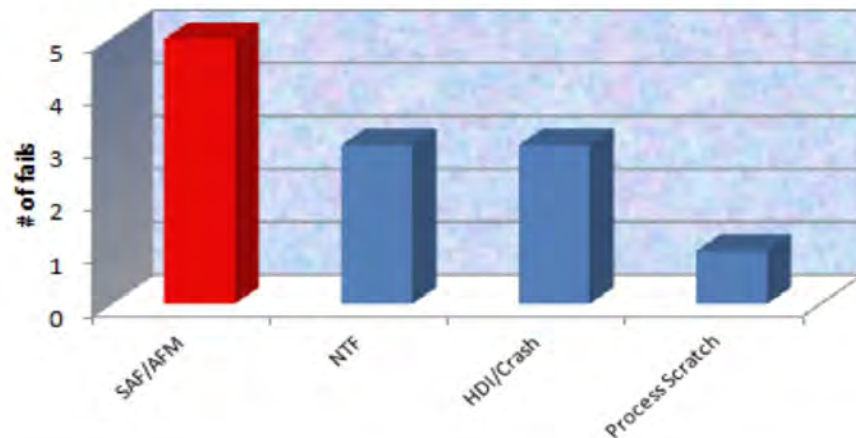
Lombard OEM Field Return AFR Trend

No Field Return Data Available Yet

Lombard Head Level Pareto (DPPM)

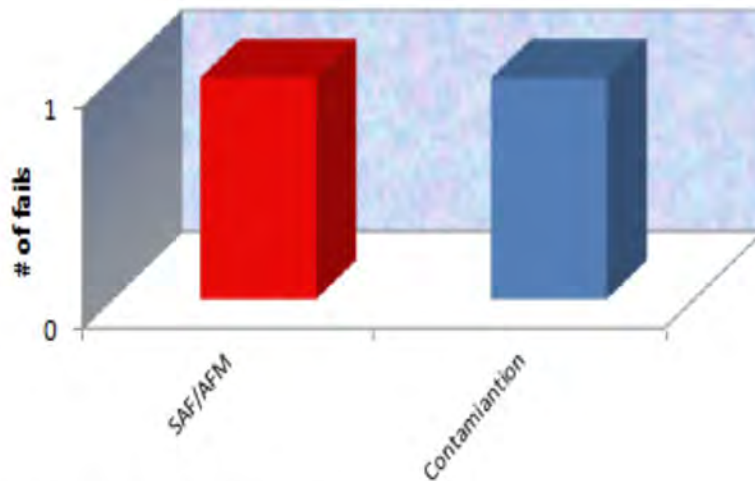
Validated via FACTS

Lombard ODT Component Level FAR
of Fails vs Type (Mar 13 - Apr 13)



**No Customer Integration
Data
Available Yet**

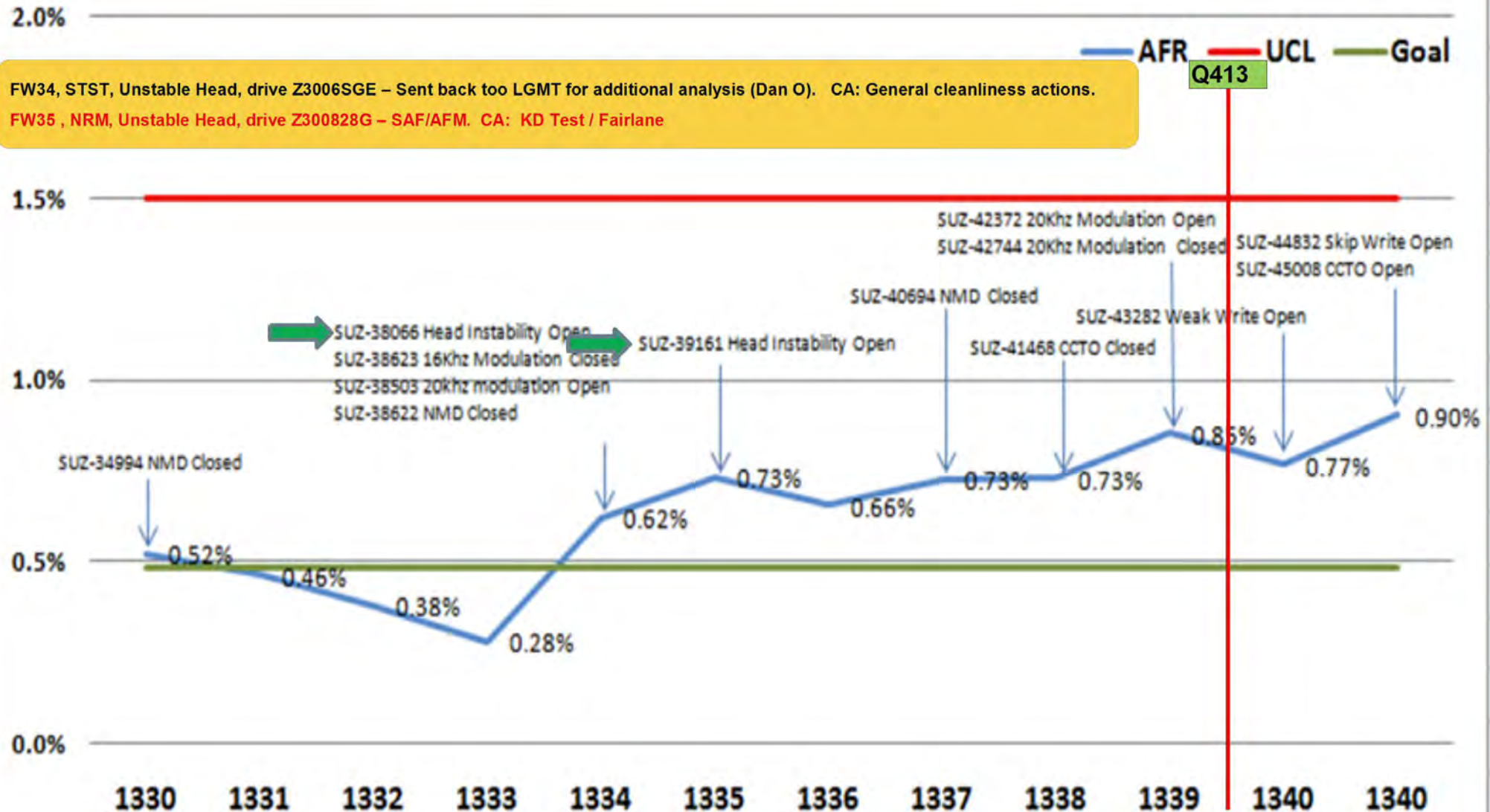
Lombard ORT Component Level FAR
of Fails vs Type (Mar 13)



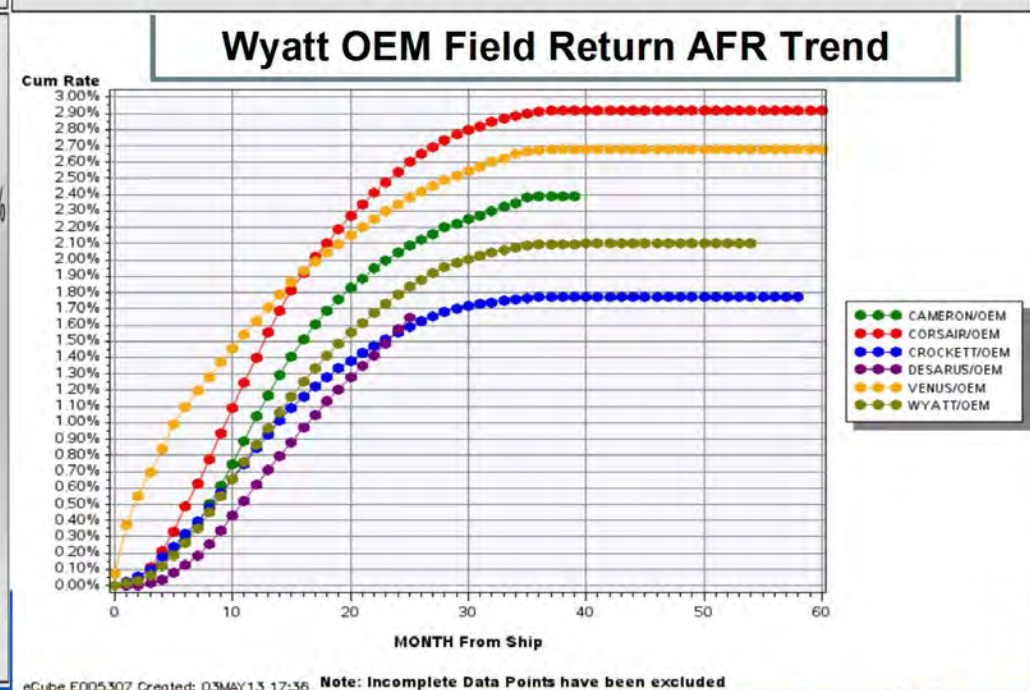
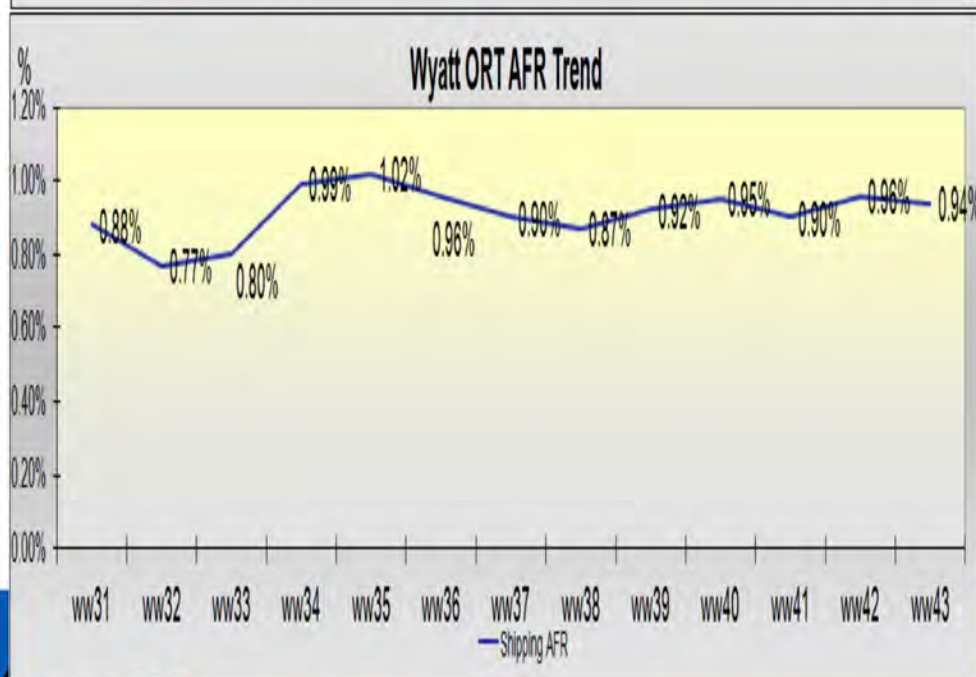
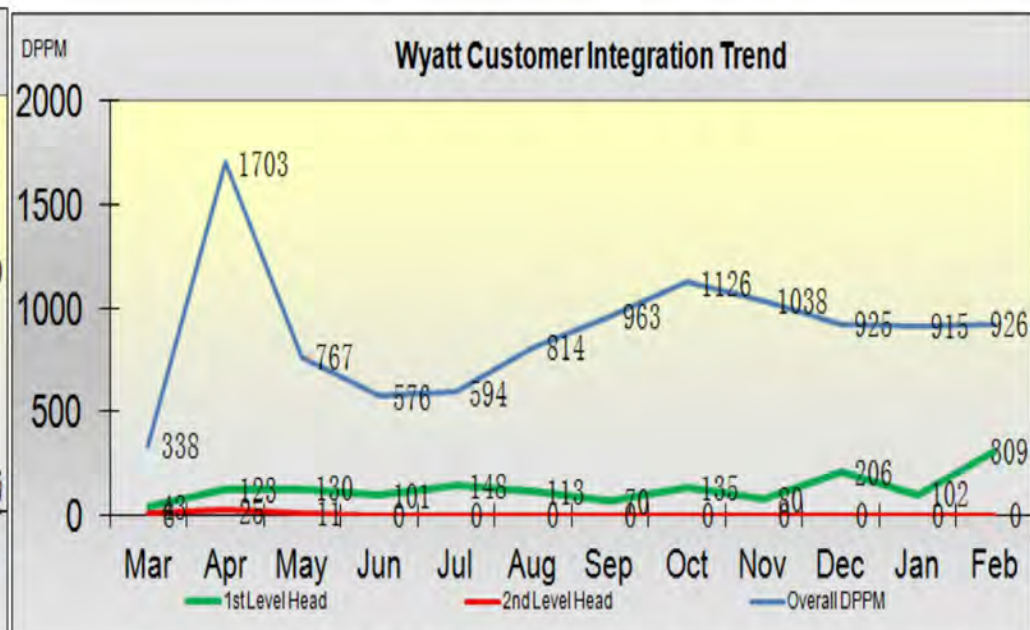
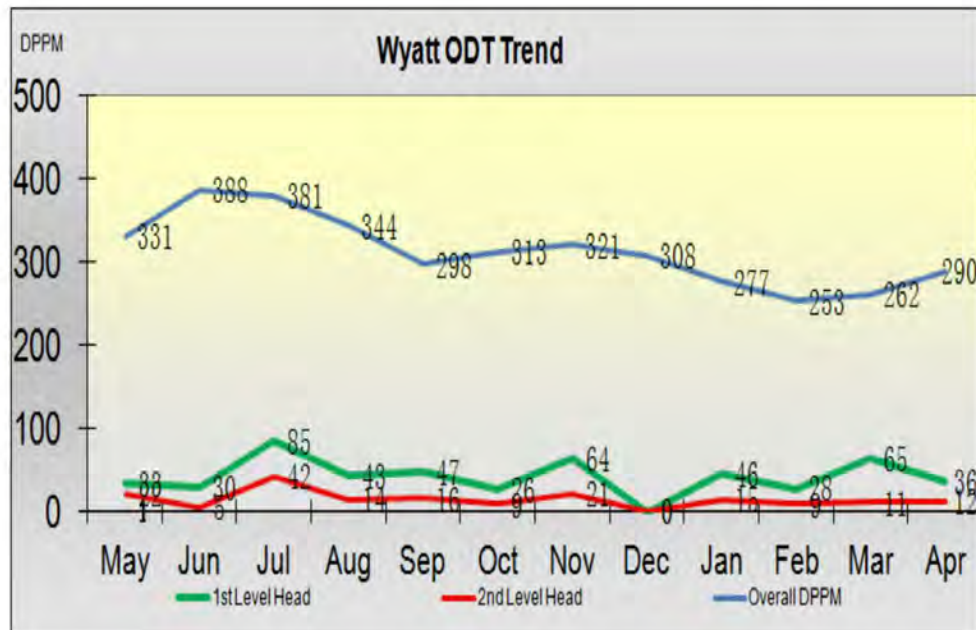
**No Field Return Data
Available Yet**

Lombard SBS ORT Q413

Lombard SBS ORT Internal AFR Trend

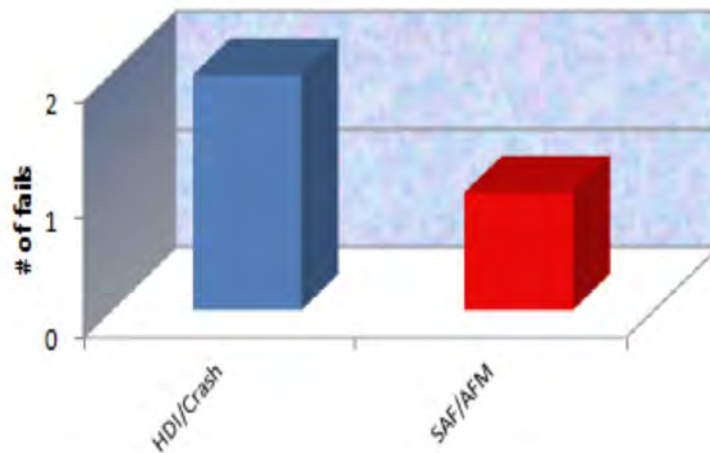


Wyatt 1st/2nd Level Drive Trends (DPPM)

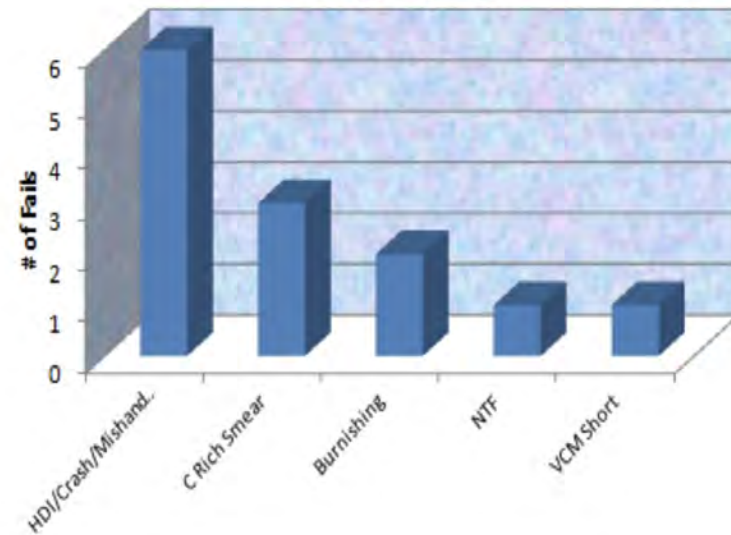


Wyatt Head Level Pareto (DPPM) Validated via FACTS

Wyatt ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)

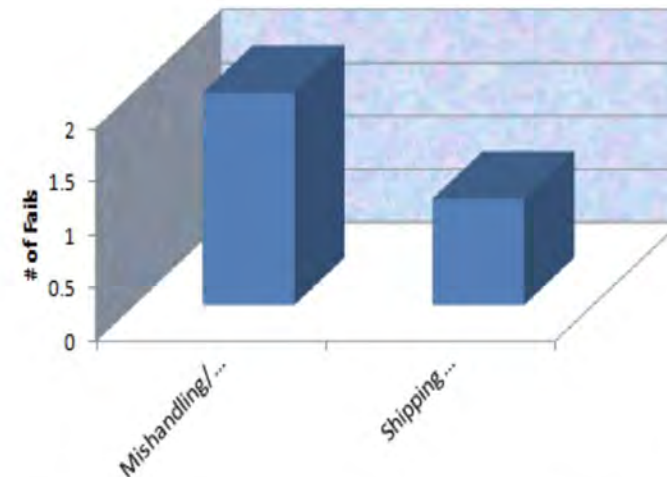


Wyatt CI Component Level FAR
of Fails vs Type (Aug 12 - Feb 13)

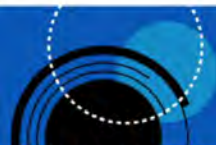
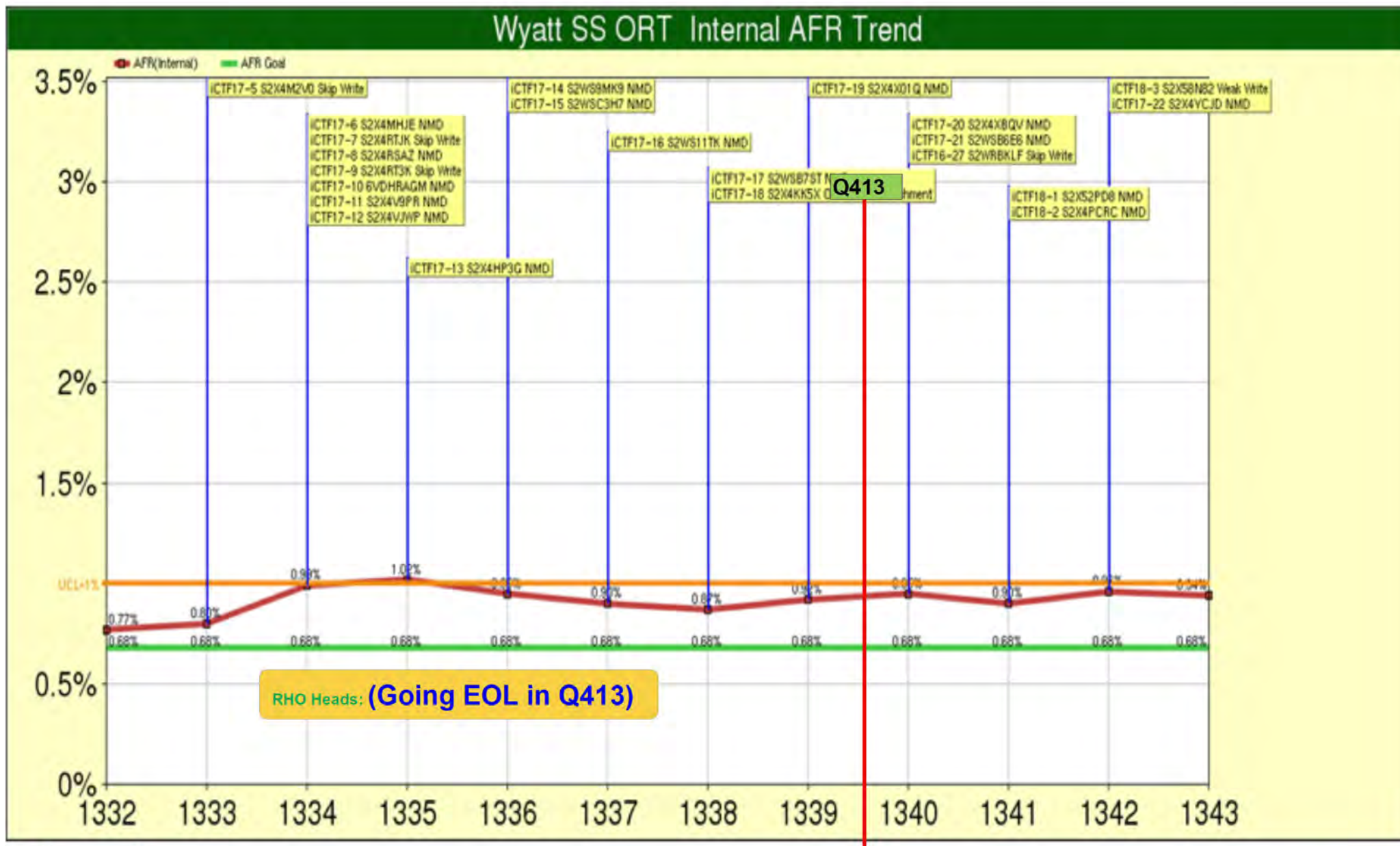


No head related failures in ORT in the last 6 months, product going EOL Q413.

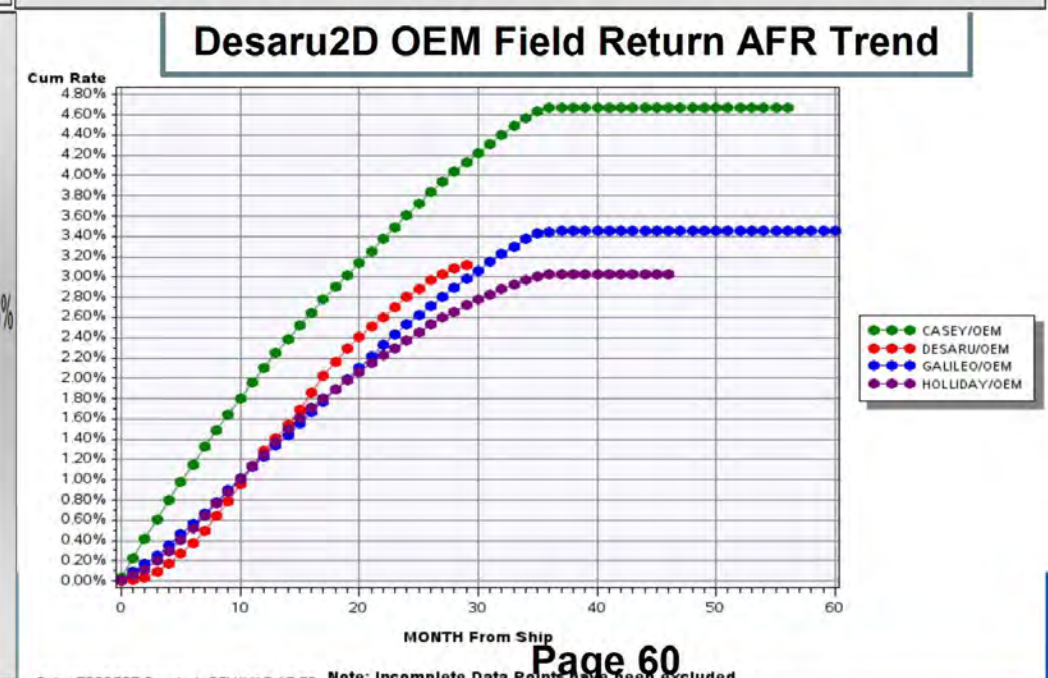
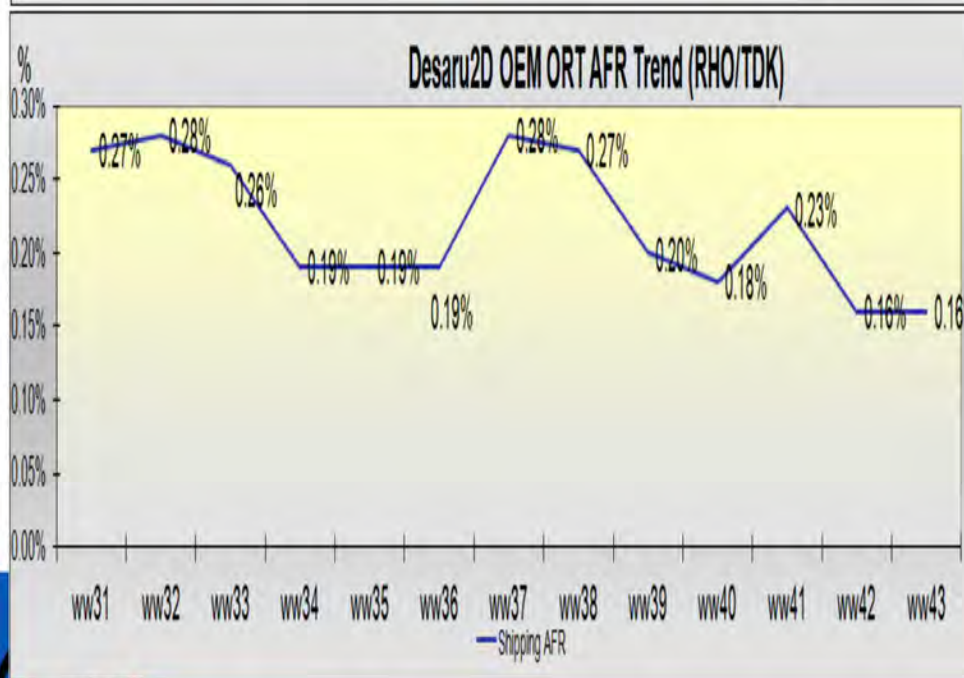
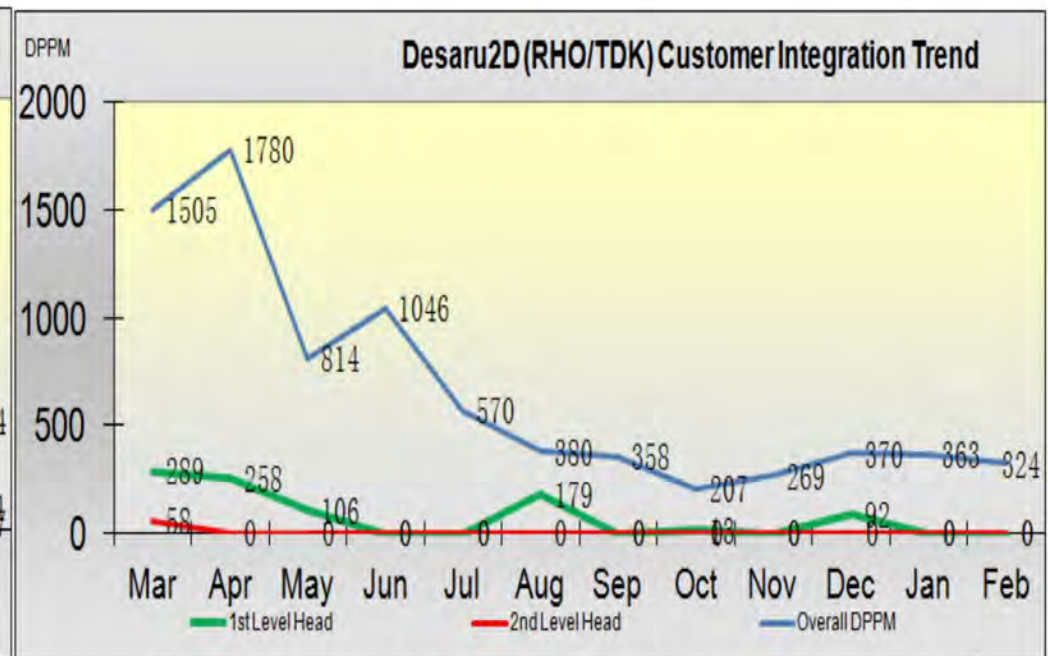
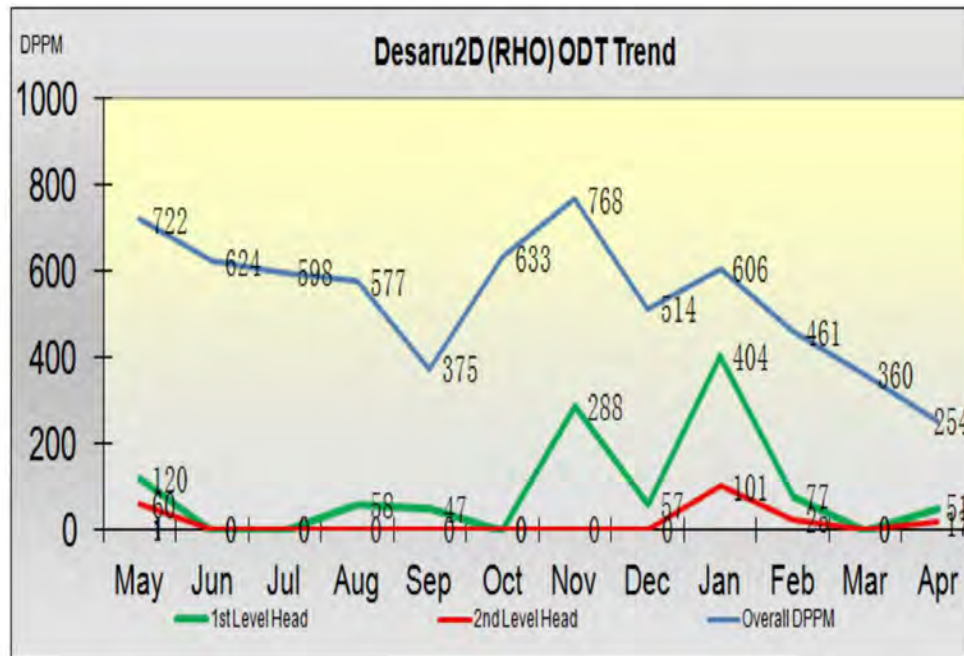
Wyatt FR Component Level FAR
of Fails vs Type (Q113 - Q213)



Wyatt SS ORT AFR Trend (Q413)



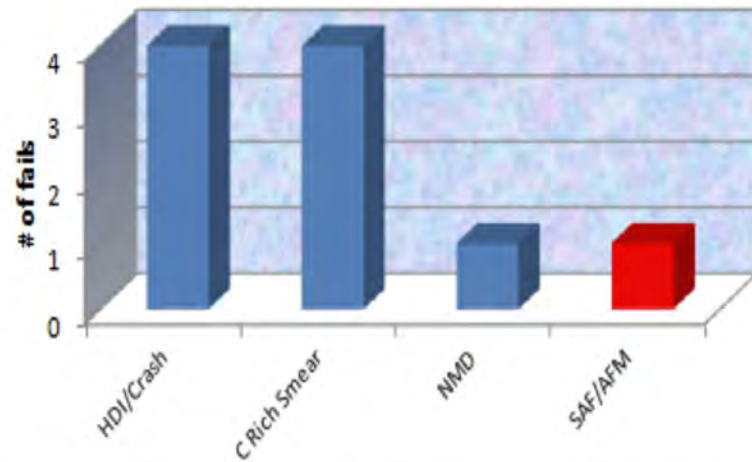
Desaru2D 1st/2nd Level Drive Trends (DPPM)



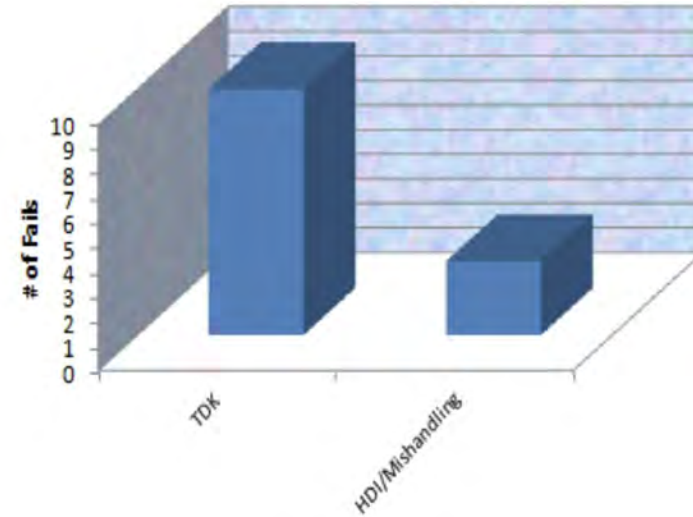
Desaru2D Head Level Pareto (DPPM)

Validated via FACTS

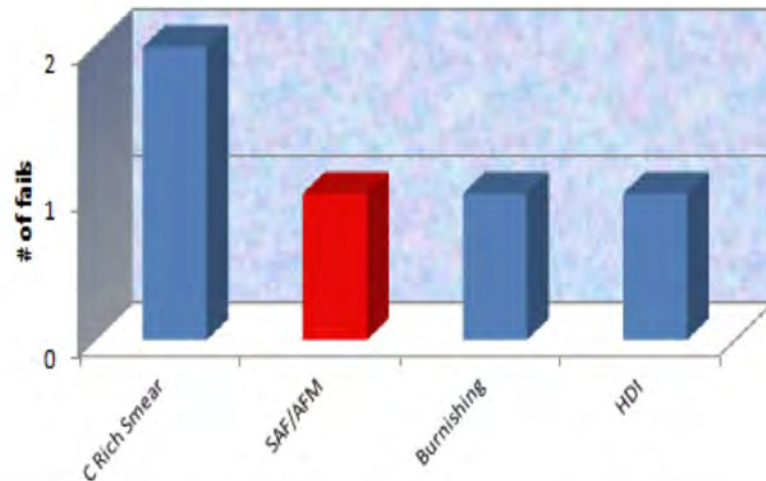
Desaru2D (RHO) ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



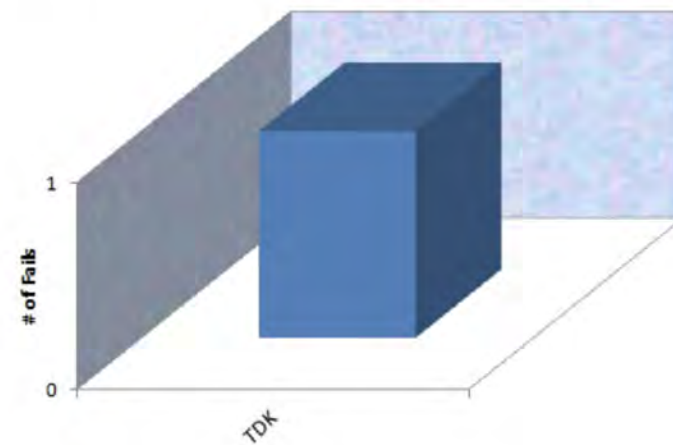
Desaru2D (RHO/TDK) CI Component Level FAR
of Fails vs Type (Aug 12 - Feb 13)



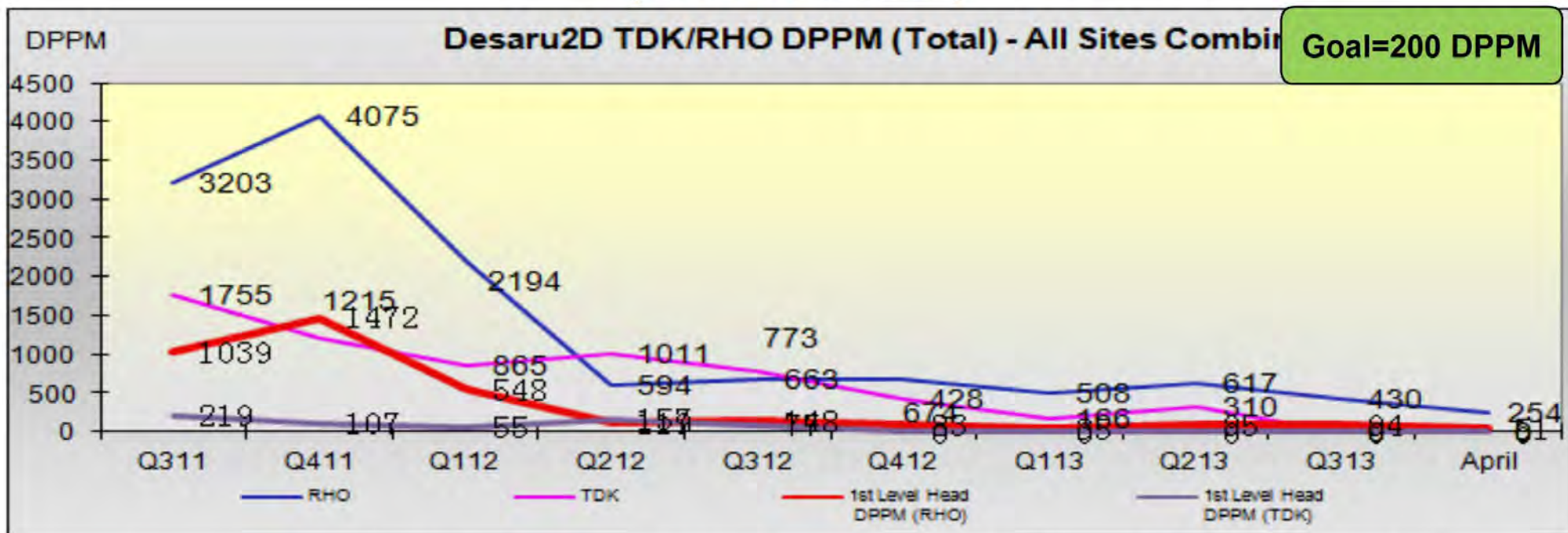
Desaru2D (RHO) ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



Desaru2D (RHO/TDK) FR Component Level FAR
of Fails vs Type (Q112 - Q213)



Desaru2D RHO/TKD ODT DPPM (Total) (All Sites Combined)



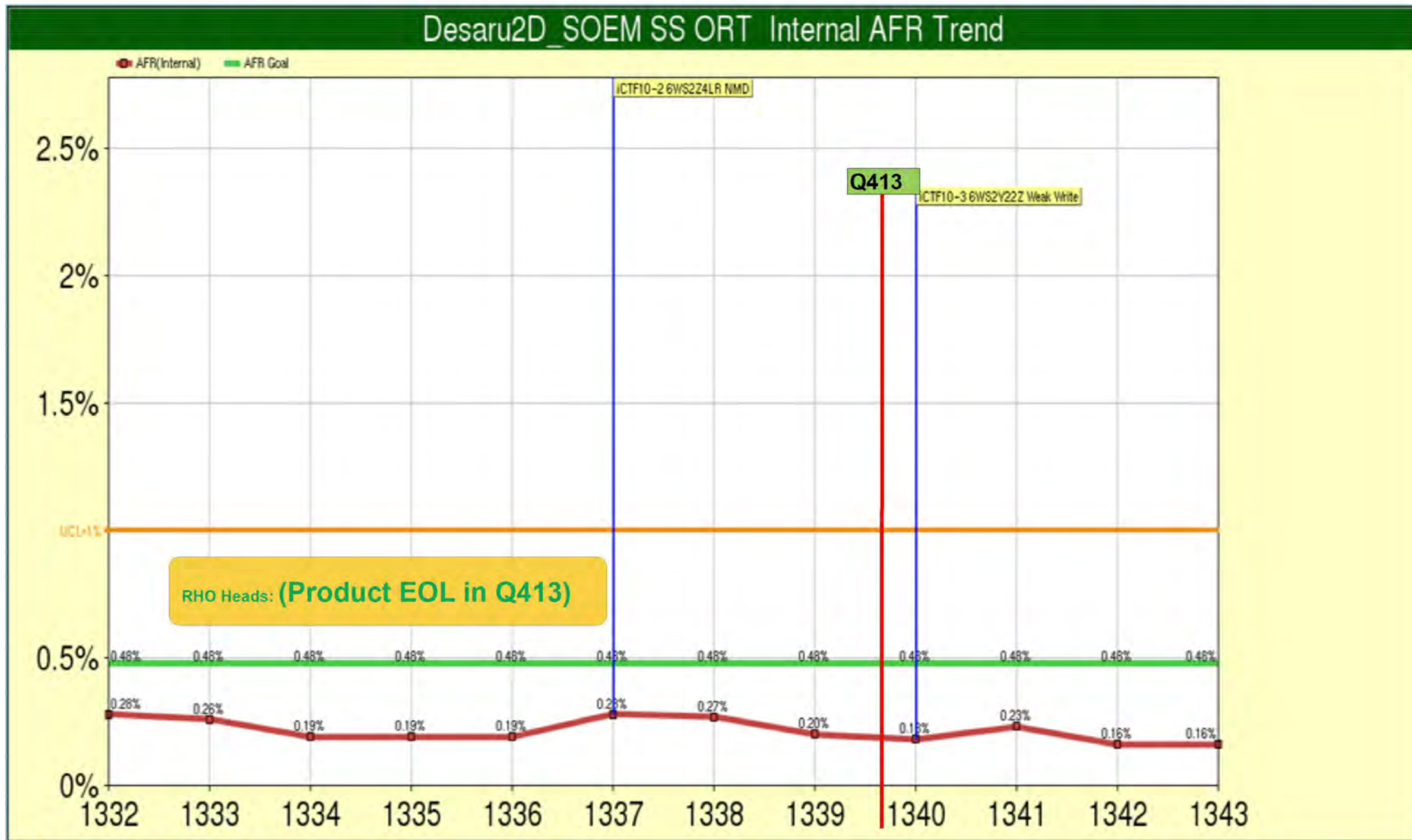
FW		Q311	Q411	Q112	Q212	Q312	Q412	Q113	Q213	Q313	April
Qty Tested (Combine)		16112	64589	95634	152382	166957	96088	69153	51835	54243	20028
No. of Failures		45	129	90	133	115	59	31	29	23	5
Weekly DPPM		2793	1997	941	873	689	614	448	559	424	250
By Vendor		Q311	Q411	Q112	Q212	Q312	Q412	Q113	Q213	Q313	April
RHO	Test Q'ty	11553	17667	5470	50466	128134	72723	57080	42151	53466	19706
	Fail Q'ty	37	72	12	30	85	49	29	26	23	5
	DPPM	3203	4075	2194	594	663	674	508	617	430	254
	1st Level Head Failures	12	26	3	6	19	6	2	4	5	1
	1st Level Head DPPM (RHO)	1039	1472	548	119	148	83	35	95	94	51
TDK	Test Q'ty	4559	46922	90164	101916	38823	23365	12073	9684	777	322
	Fail Q'ty	8	57	78	103	30	10	2	3	0	0
	DPPM	1755	1215	865	1011	773	428	166	310	0	0
	1st Level Head Failures	1	5	5	16	3	0	0	0	0	0
	1st Level Head DPPM (TDK)	219	107	55	157	77	0	0	0	0	0

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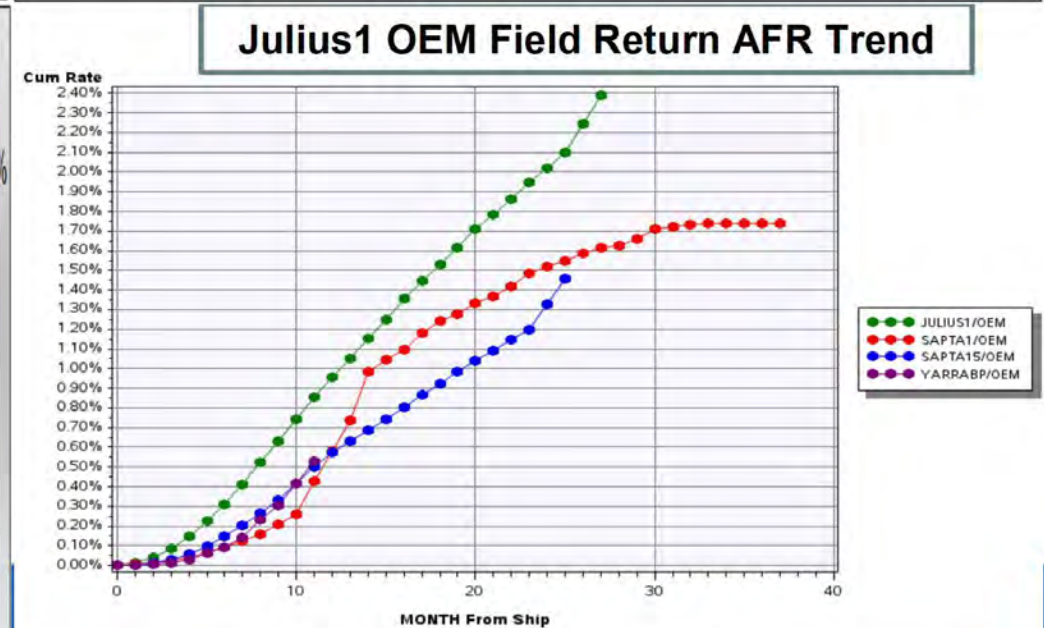
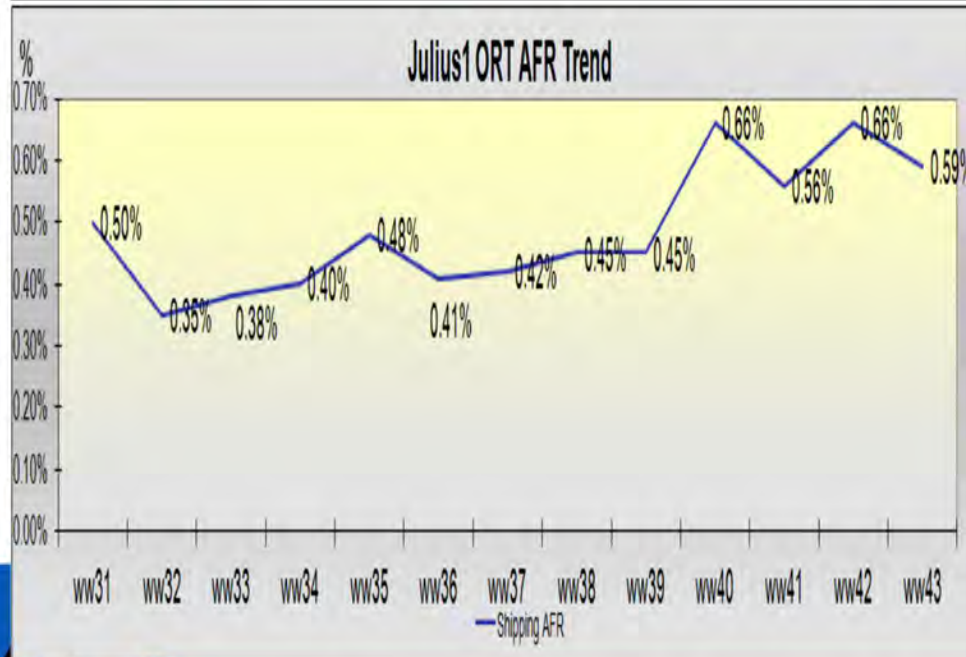
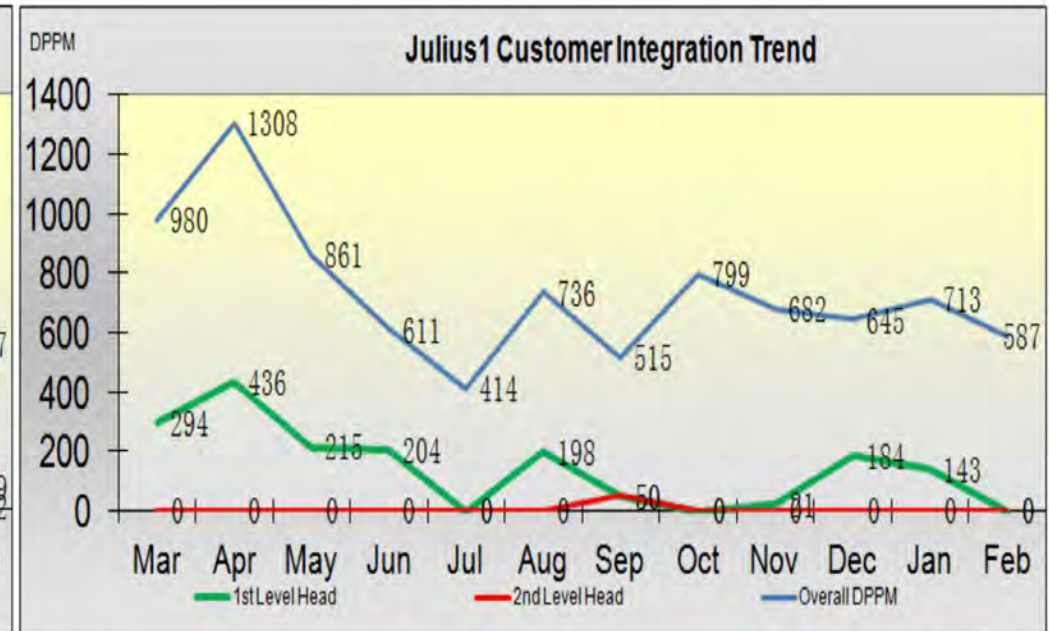
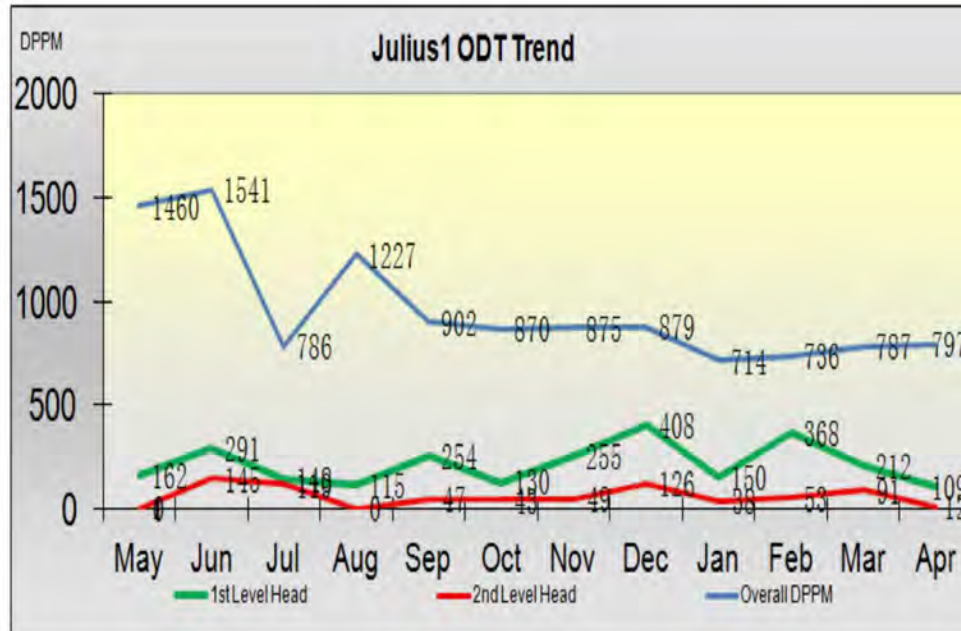
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Desaru2D OEM ORT AFR Trend (Q413)



Julius1 1st/2nd Level Drive Trends (DPPM)

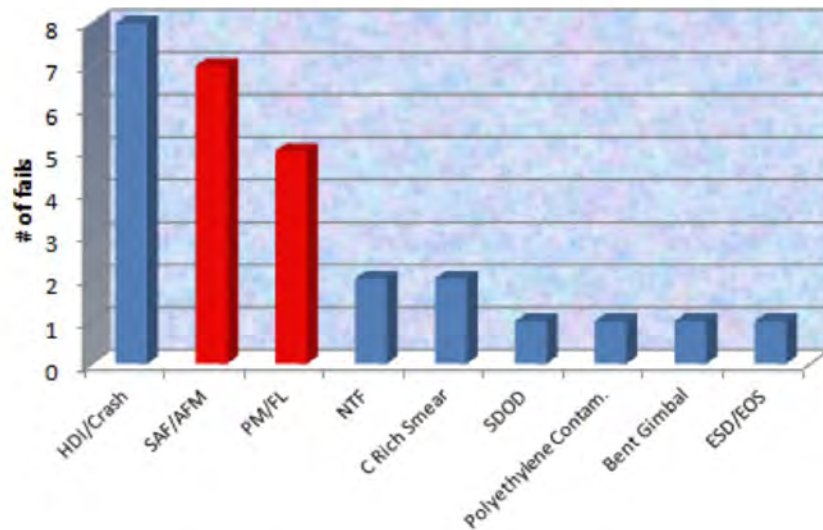


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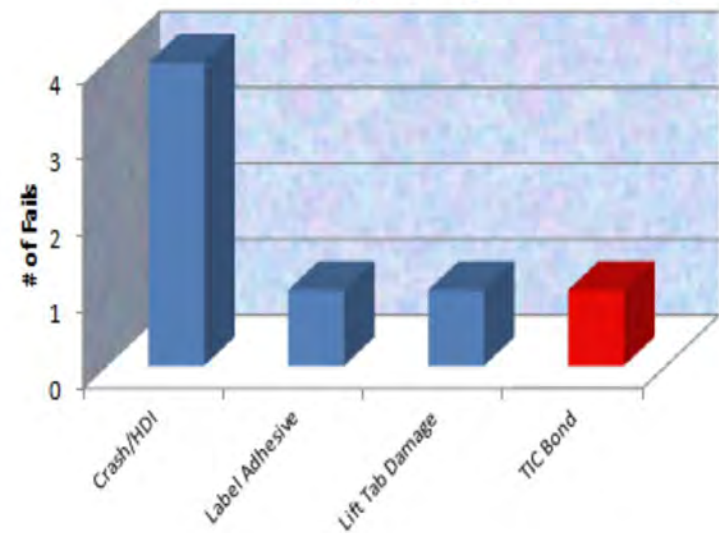
Julius1 Head Level Pareto (DPPM)

Validated via FACTS

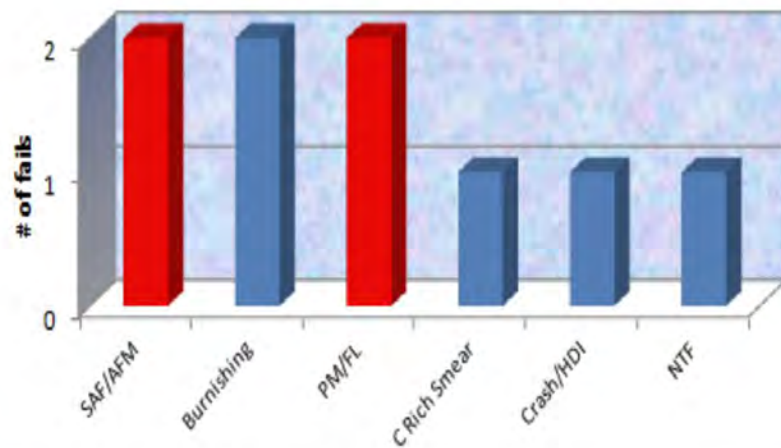
Julius1 ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



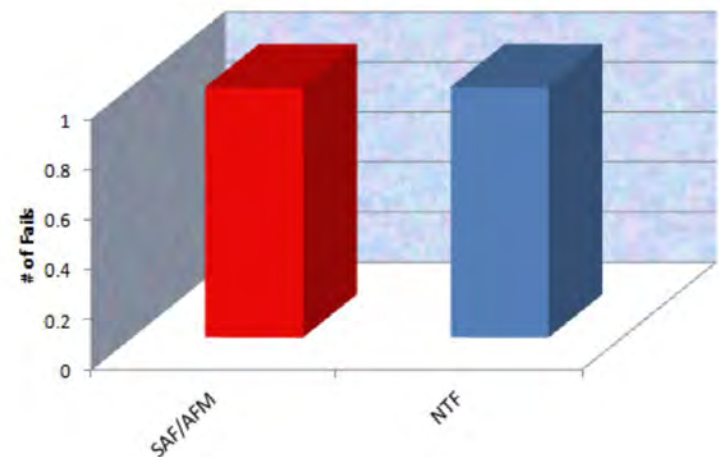
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of Fails vs Type (Aug 12 - Feb 13)



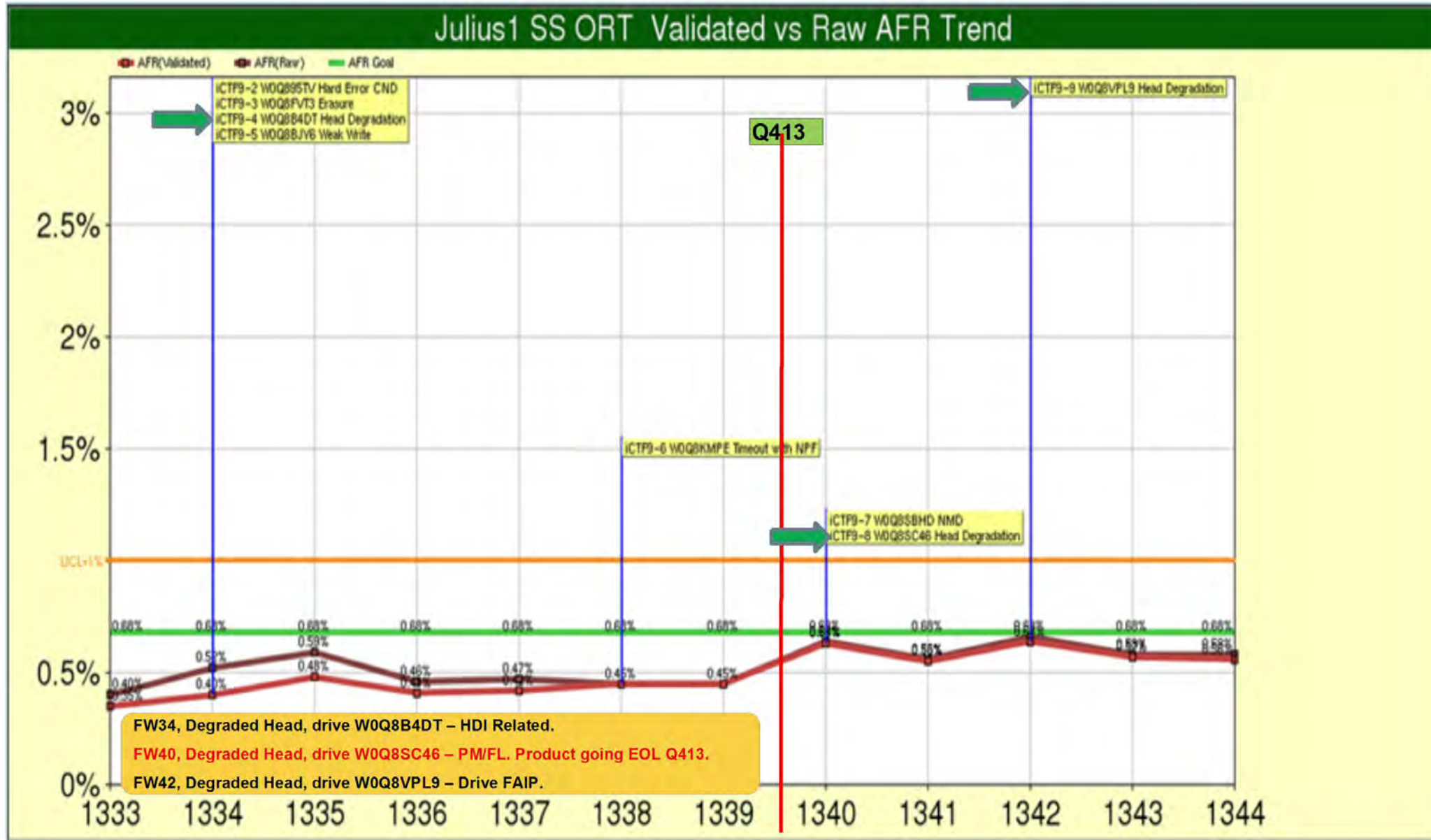
Julius1 ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



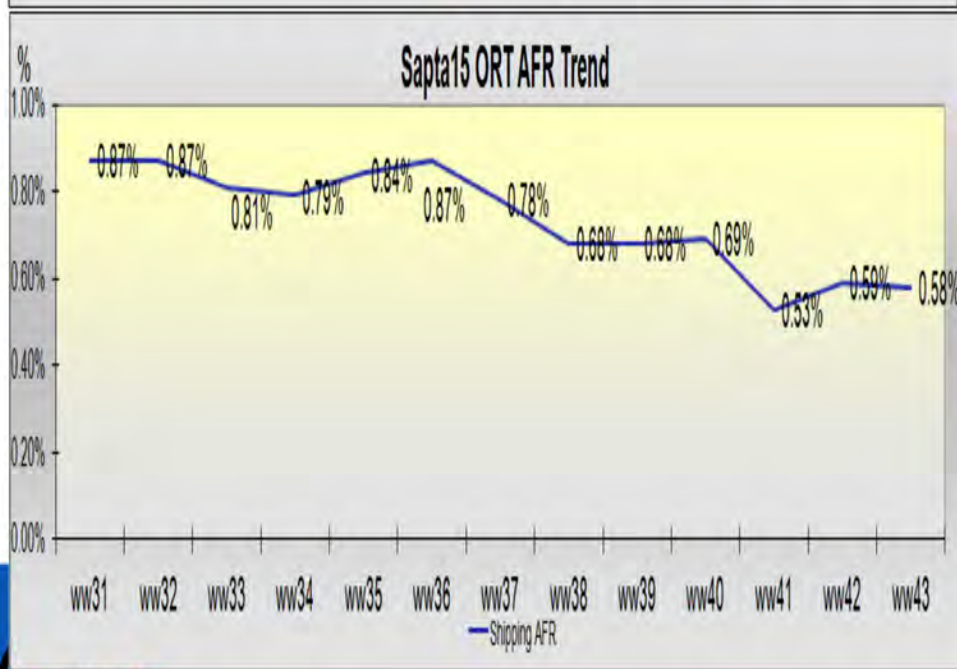
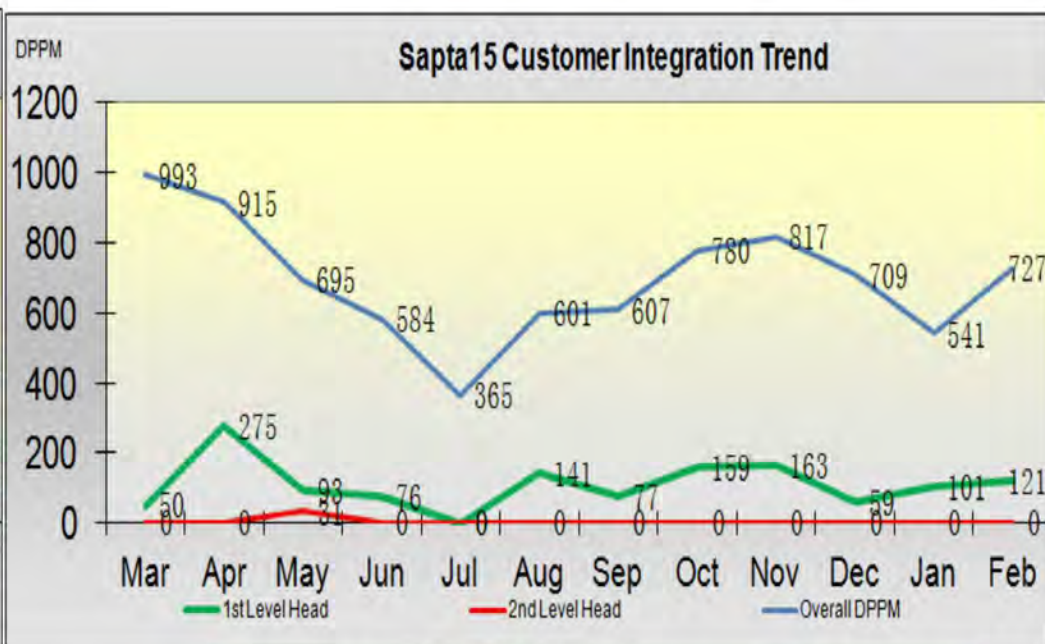
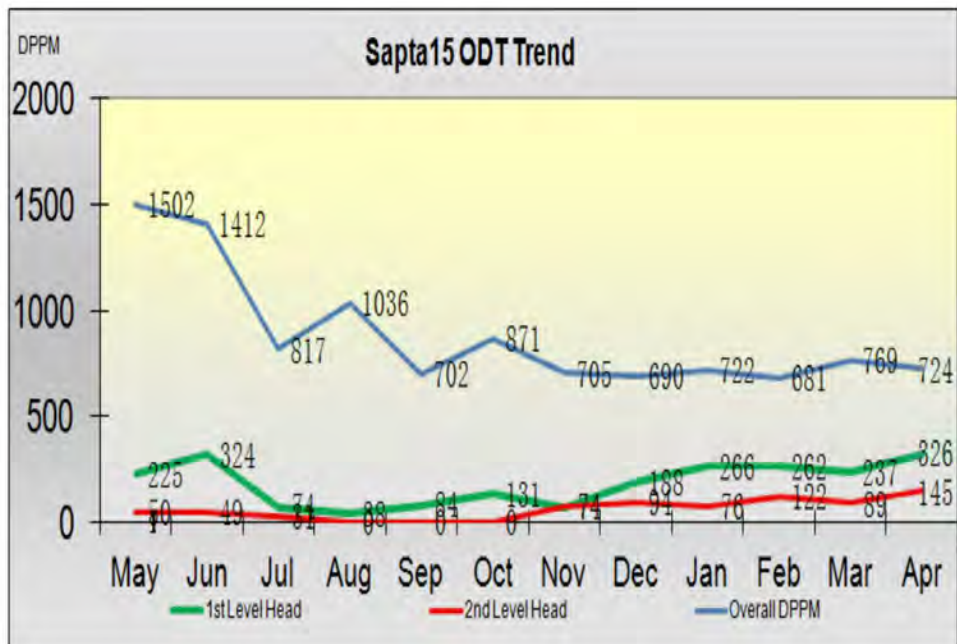
Julius1 FR Component Level FAR
of Fails vs Type (Q113 - Q213)



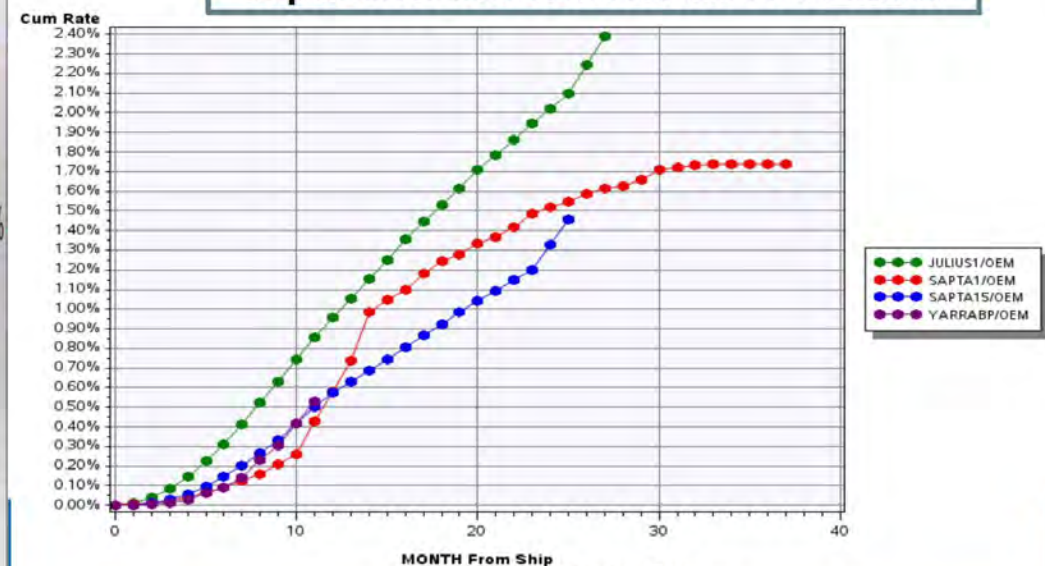
Julius1 ORT AFR Trend - (Q413)



Sapta15 1st/2nd Level Drive Trends (DPPM)



Sapta15 OEM Field Return AFR Trend

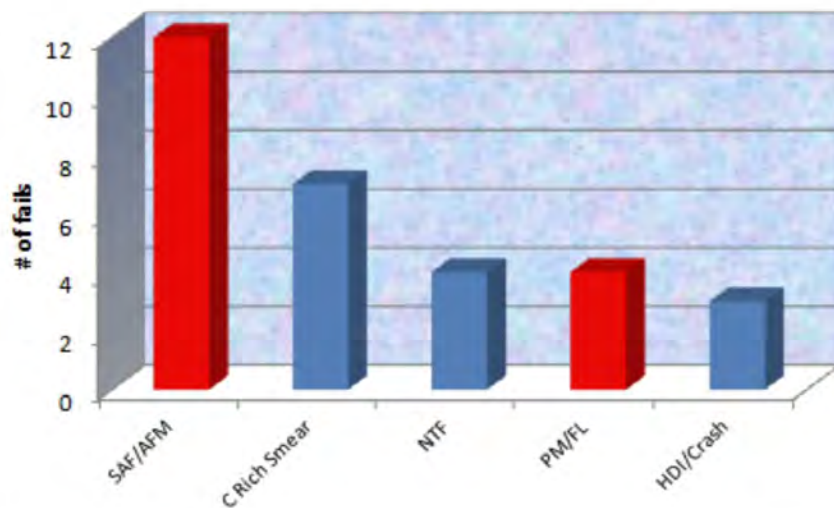


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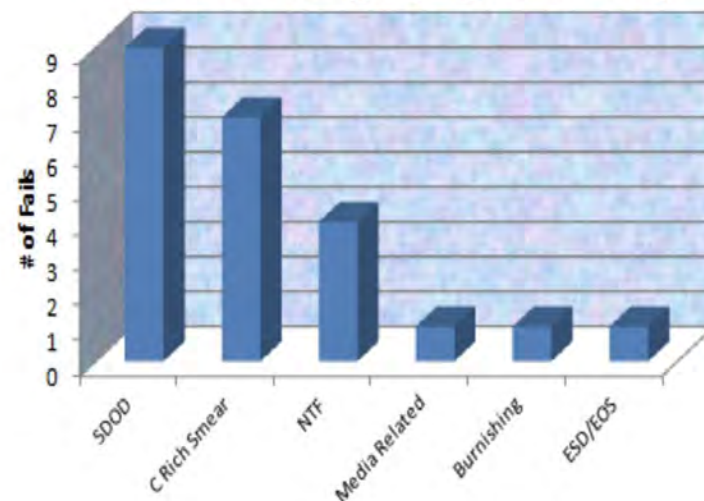
Sapta15 Head Level Pareto (DPPM)

Validated via FACTS

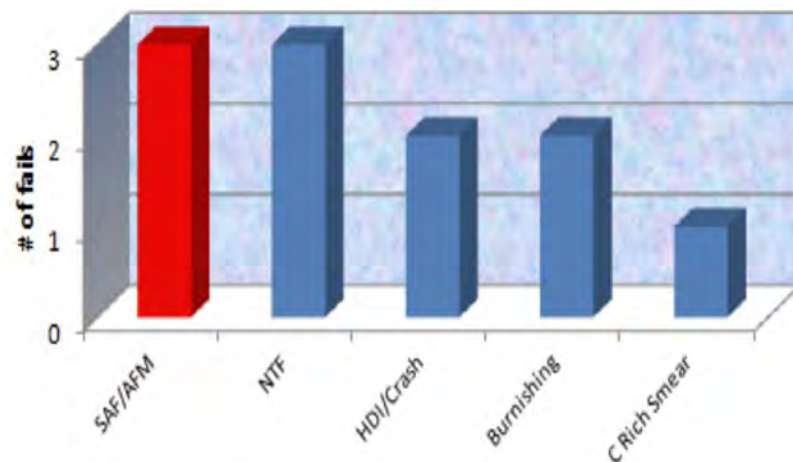
Sapta15 ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



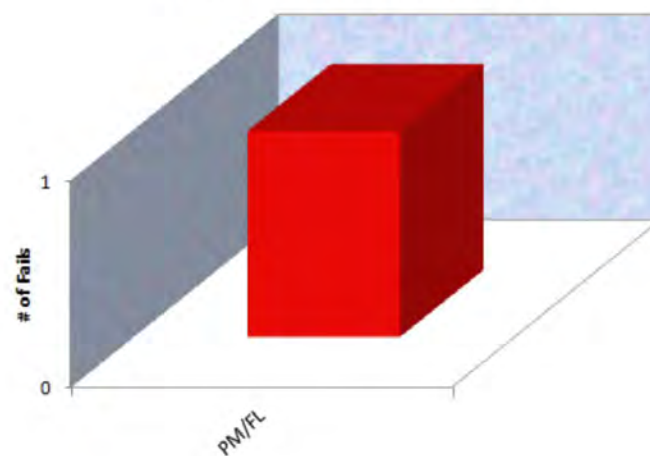
Sapta15 CI Component Level FAR
of Fails vs Type (Aug 12 - Feb 13)



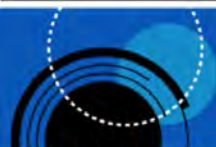
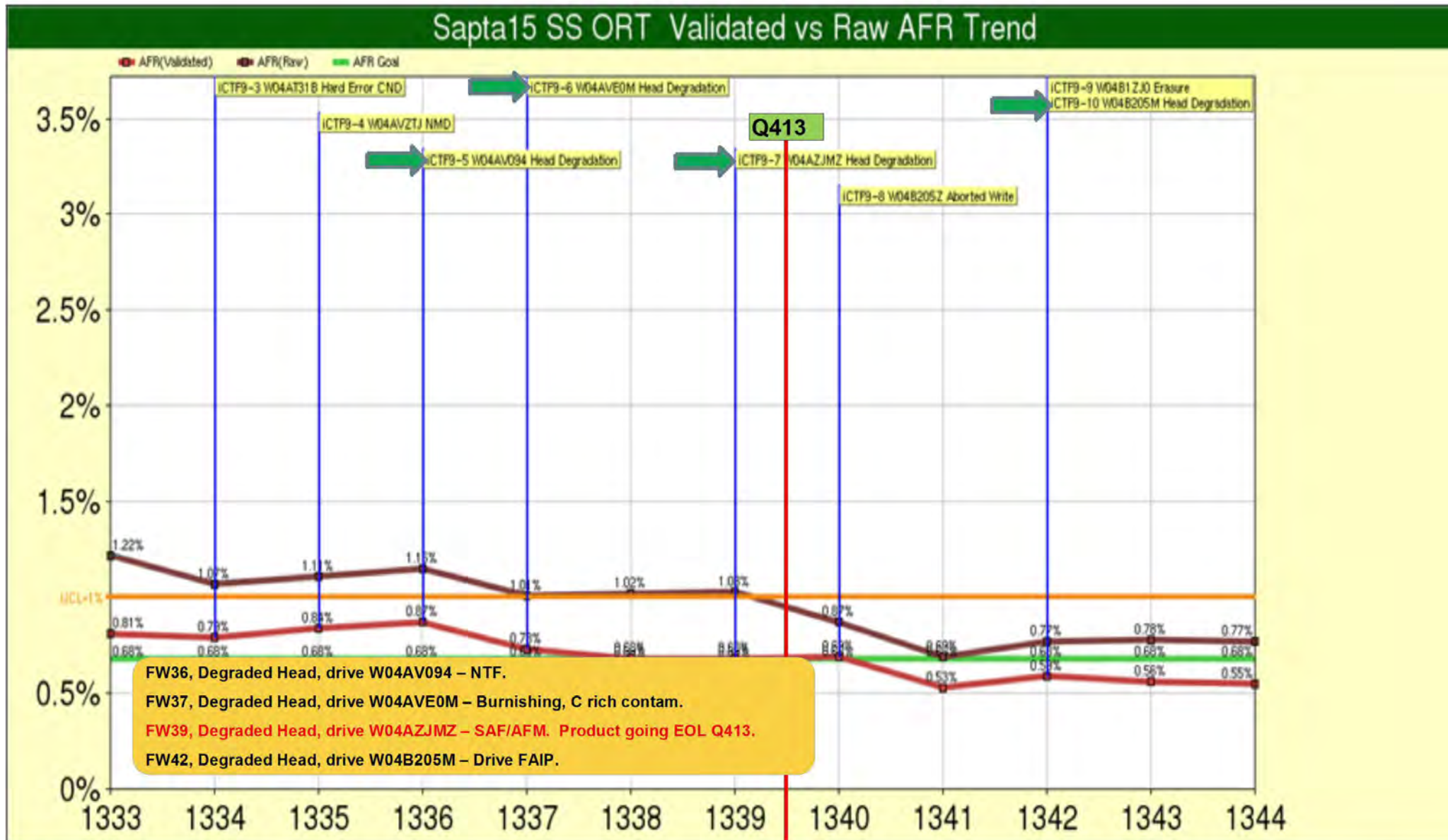
Sapta15 ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



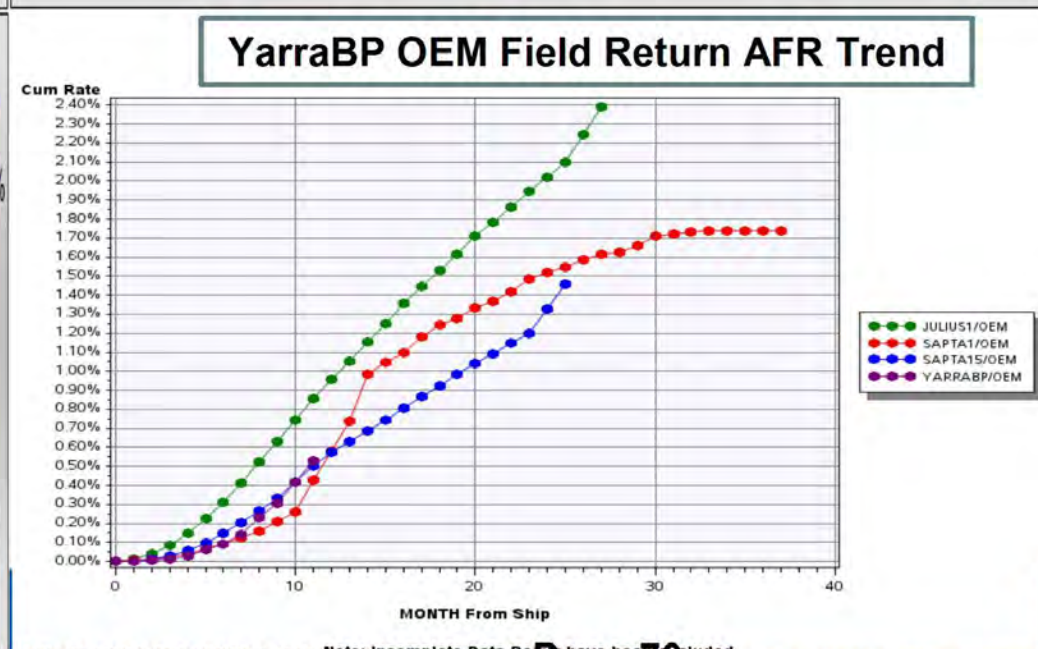
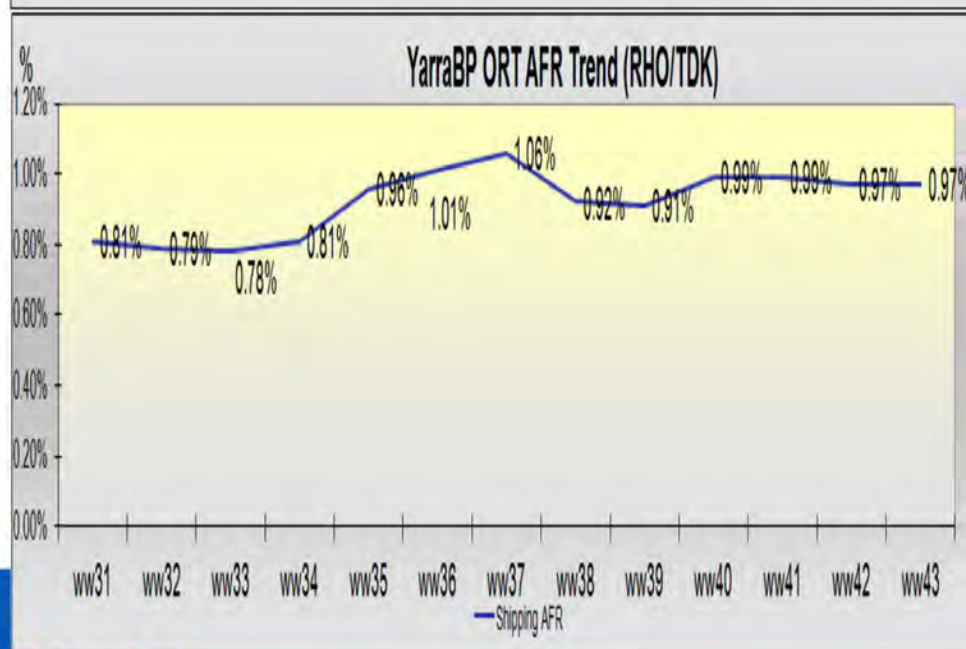
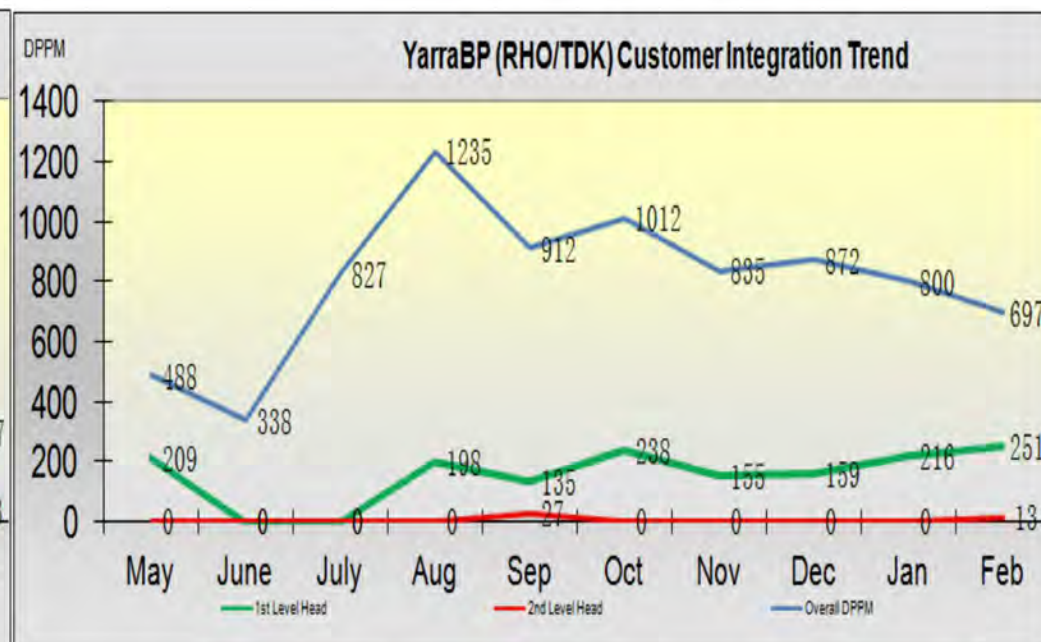
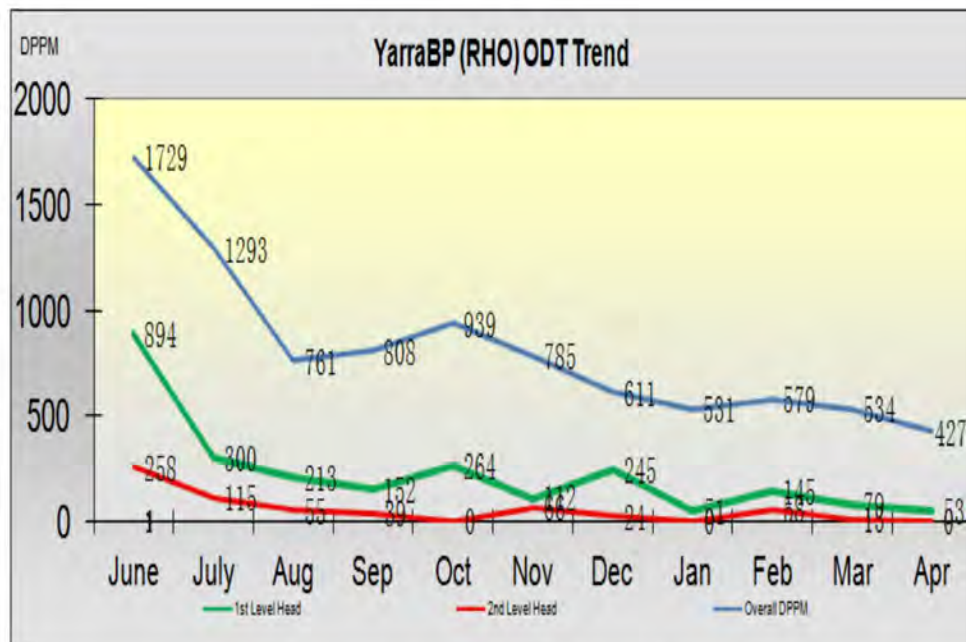
Sapta15 FR Component Level FAR
of Fails vs Type (Q113-Q213)



Sapta15 ORT AFR Trend - (Q413)



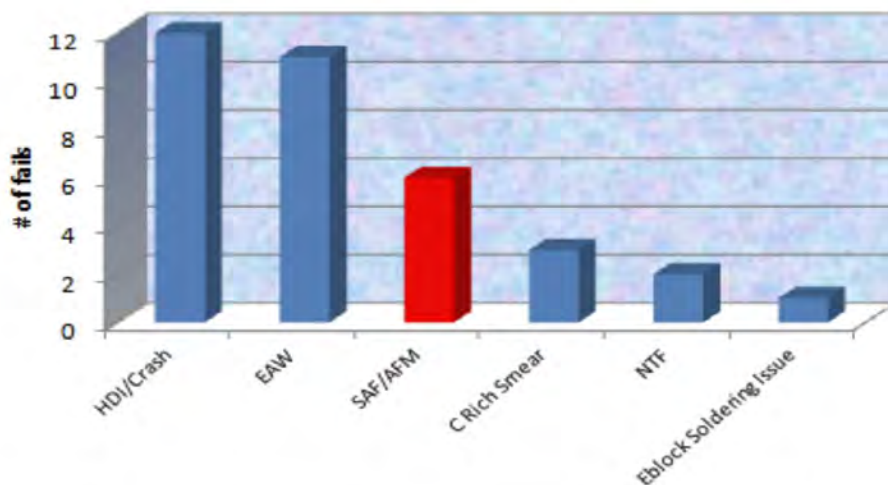
YarraBP 1st/2nd Level Drive Trends (DPPM)



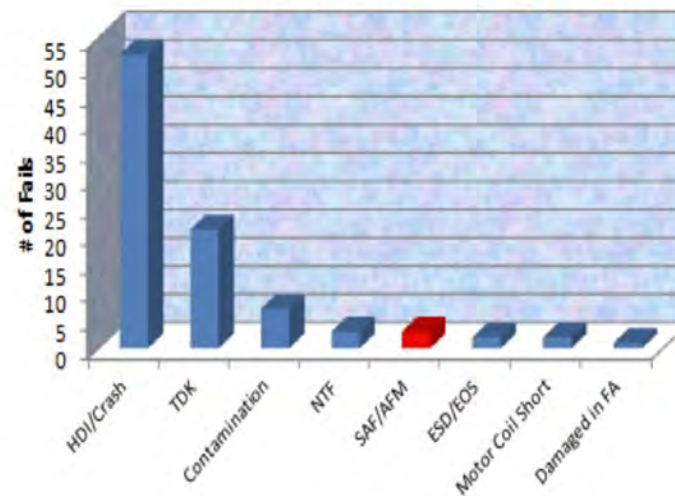
YarraBP Head Level Pareto (DPPM)

Validated via FACTS

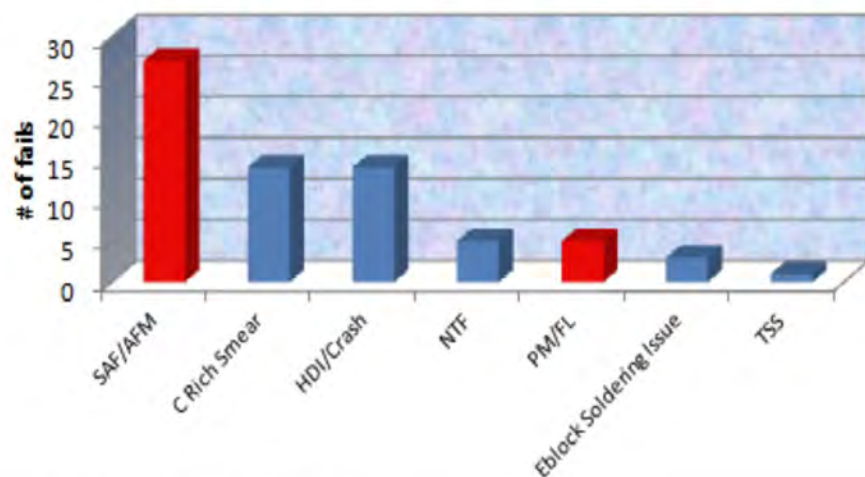
YarraBP (RHO) ODT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



YarraBP (RHO/TK) CI Component Level FAR
of Fails vs Type (Aug 12 - Feb 13)



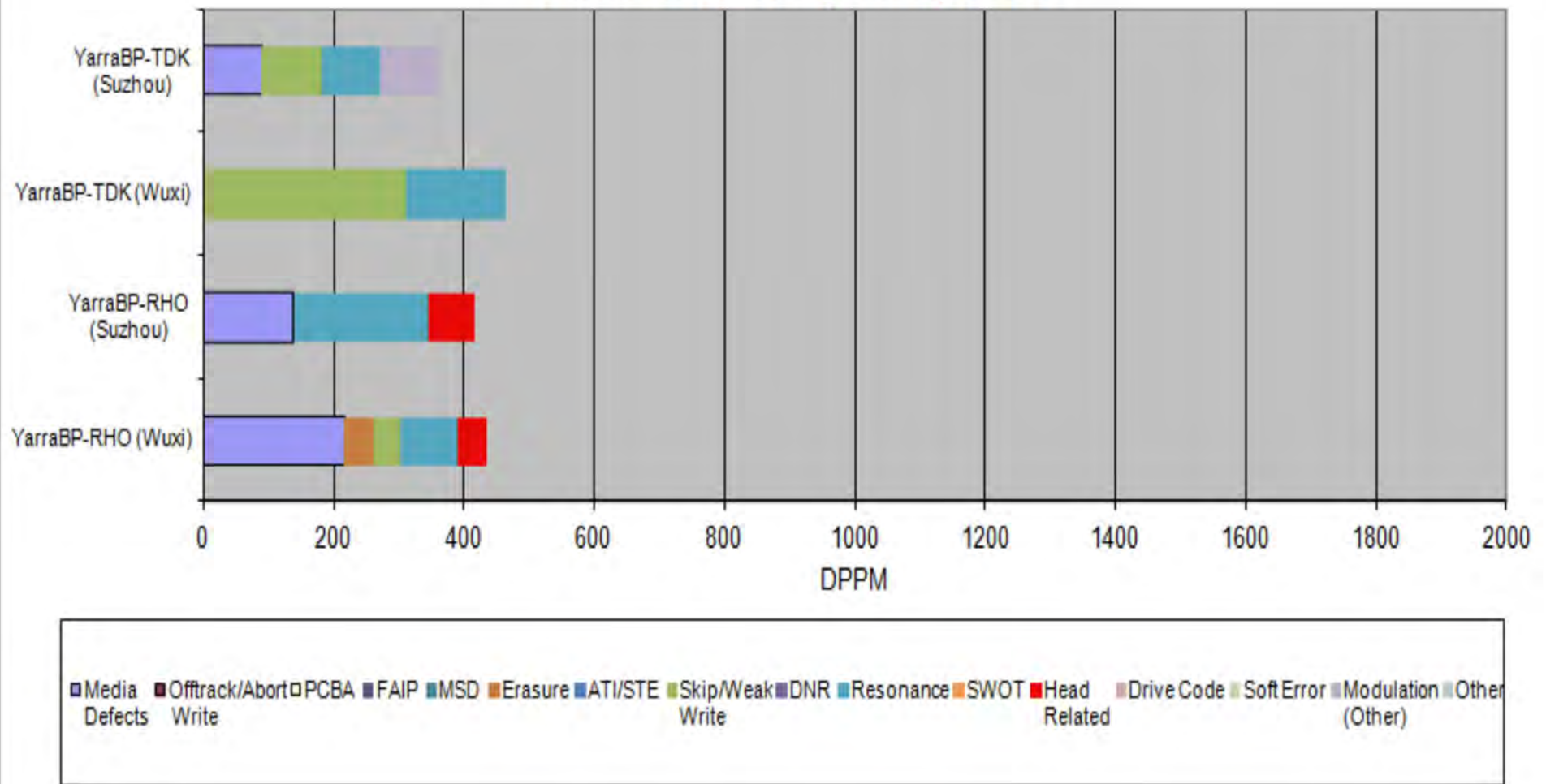
YarraBP (RHO) ORT Component Level FAR
of Fails vs Type (Oct 12 - Apr 13)



**No Head Related Field
 Return Data
 Available Yet**

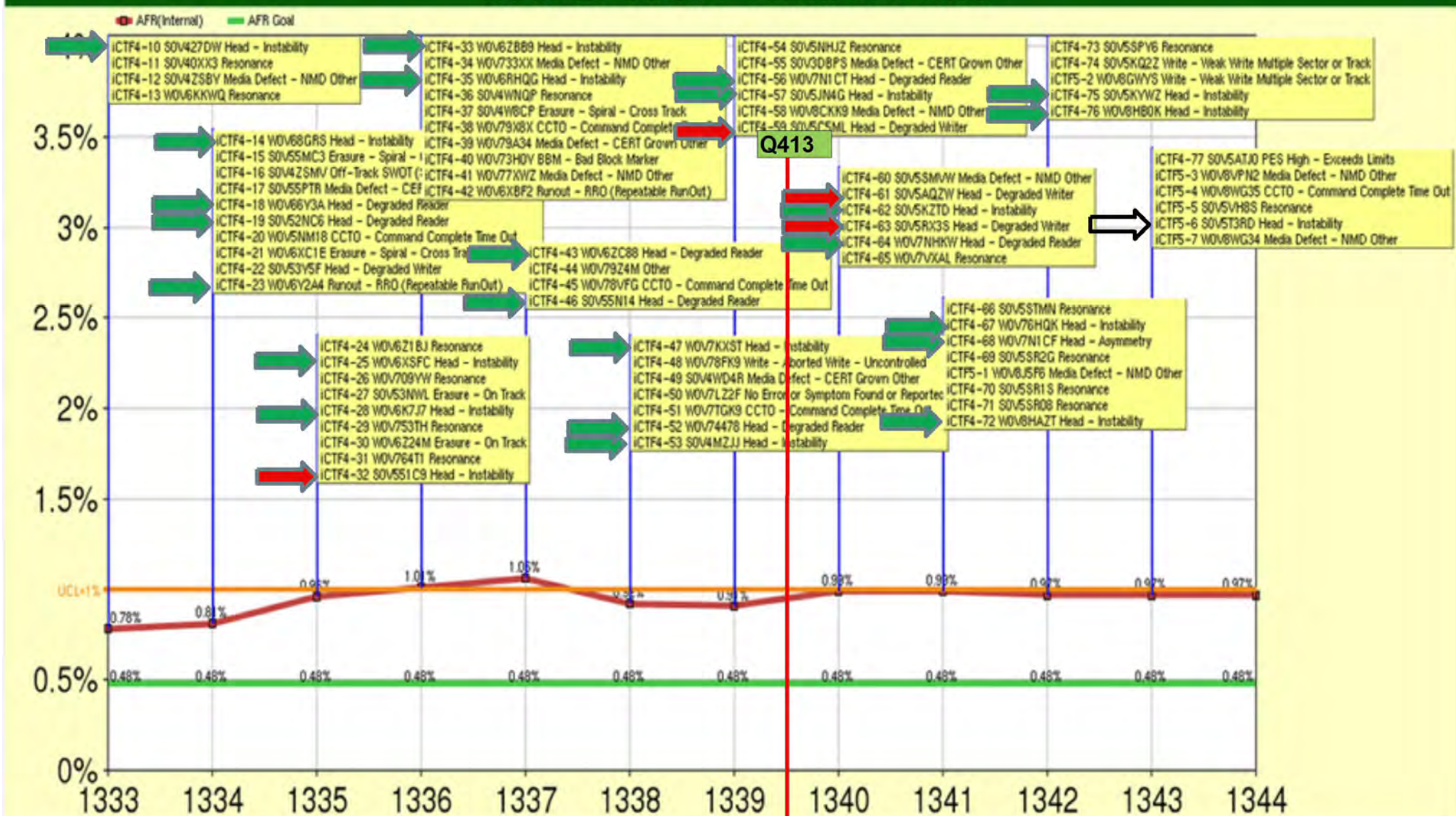
YarraBP ODT Trends by Drive Build Site (DPPM)

YarraBP ODT Pareto by Site - April 2013



YarraBP ORT AFR Trend - (Q413)

YARRABP SS ORT Internal AFR Trend



TDK HEAD

RHO HEAD

UNKNOWN - (NOT IN FACTS)

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YarraBP ORT FA Status - (Q413)

FW33, Unstable Head, drive S0V427DW – C/F Smears

FW34, Unstable Head, drive W0V68GRS – SAF/AFM

FW34, Degraded Head, drive W0V66Y3A – NTF.

FW34, Degraded Writer, drive S0V53Y5F – C/F Smears

FW34, Degraded Head, drive S0V52NC6 – SAF/AFM

FW35, Unstable Head, drive W0V6XSFC – HDI Related C rich.

FW35, Unstable Head, drive W0V6K7J7 – SAF/AFM.

FW36, Unstable Head, drive W0V6ZBB9 – SAF/AFM.

FW36, Unstable Head, drive W0V6RHQG – SAF/AFM.

FW37, Degraded Head, drive W0V6ZC88 – HDI Related

FW37, Degraded Head, drive S0V55N14 – SAF/AFM

FW38, Unstable Head, drive W0V7KXST – Contamination Related.

FW38, Unstable Head, drive SOV4MZJJ - C/F Smears

FW38, Degraded Head, drive W0V74478 – Particle/Contam Related.

FW39, Unstable Head, drive S0V5JN4G – HDI Related.

FW39, Degraded Head, drive W0V7N1CT – C/F Smears.

FW40, Unstable Head, drive S0V5KZTD – TSS

FW40, Degraded Head, drive W0V7NHKW – SAF/AFM.

FW41, Unstable Head, drive W0V76HQK – SAF/AFM

FW41, Asymmetry, drive W0V7N1CF – SAF/AFM

FW41, Unstable Head, drive W0V8HAZT – HDI Related.

FW42, Unstable Head, drive S0V5KYWZ – HDI Related, possible media corrosion.

FW42, Unstable Head, drive W0V8HB0K – SAF/AFM



YarraBP RHO Instability Improvement

Failure Mode	Improvement Actions	DPPM Impact	FE%	DPPM Reduction	ECD	Owner
NMD	Add combo screen for high defect_count in D_flawscan & SFT by zone	146	5%	7	FW45	Tang Yong
Weak Write	Combo screen cut in for weak write(Burnish & OW)	72	5%	5	FW41	Tang Yong
Resonance/Modulation	Turn on clr screen(ID clr & ID/OD clr delta) spec for STD drive	146	5%	7	FW41	Tang Yong
	Switch back to old NHK design(Non-HLG)		30%	44	FW46	RHO Team
	MPT 5.5.1 TGA to mitigate the 1st sway mode issue		10%	15	FW47	Janet Leow
Head Instability	Stripe height change	18	0%	0	TBD	Janet Leow
EAW	Further study is ongoing	18	0%	0	TBD	ASE Team
Head Degradation	Further study is ongoing	18	0%	0	TBD	ASE Team

Blue font: pending cut in

Average DPPM (WW40-43) 418

Expected Reduction 78

Expected DPPM 340



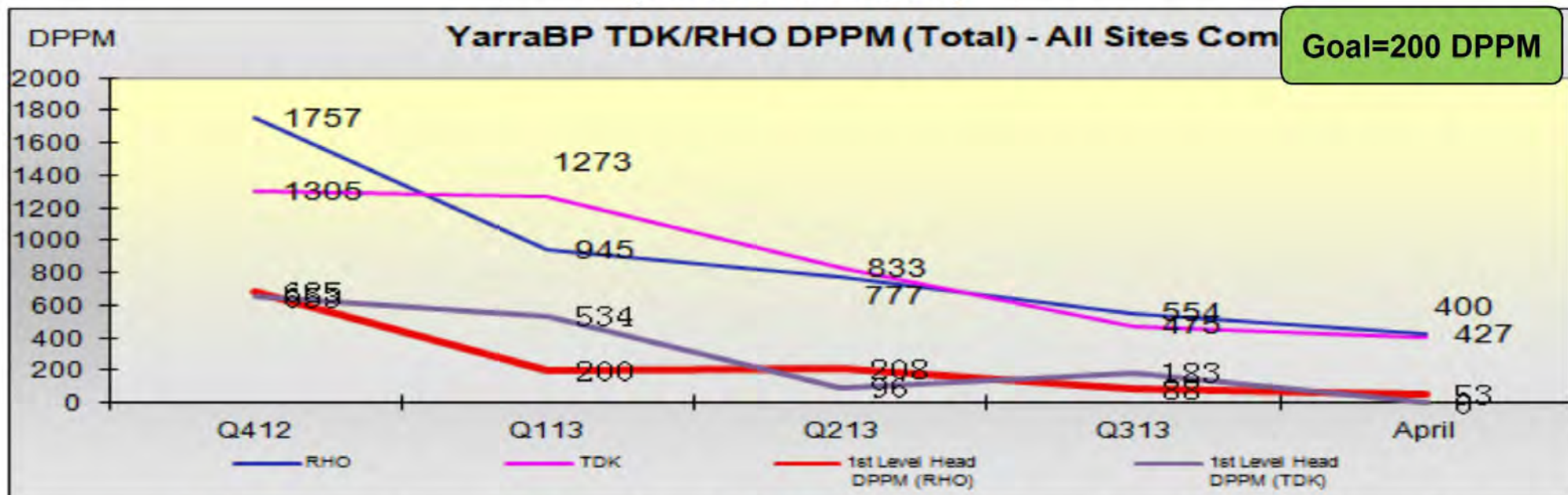
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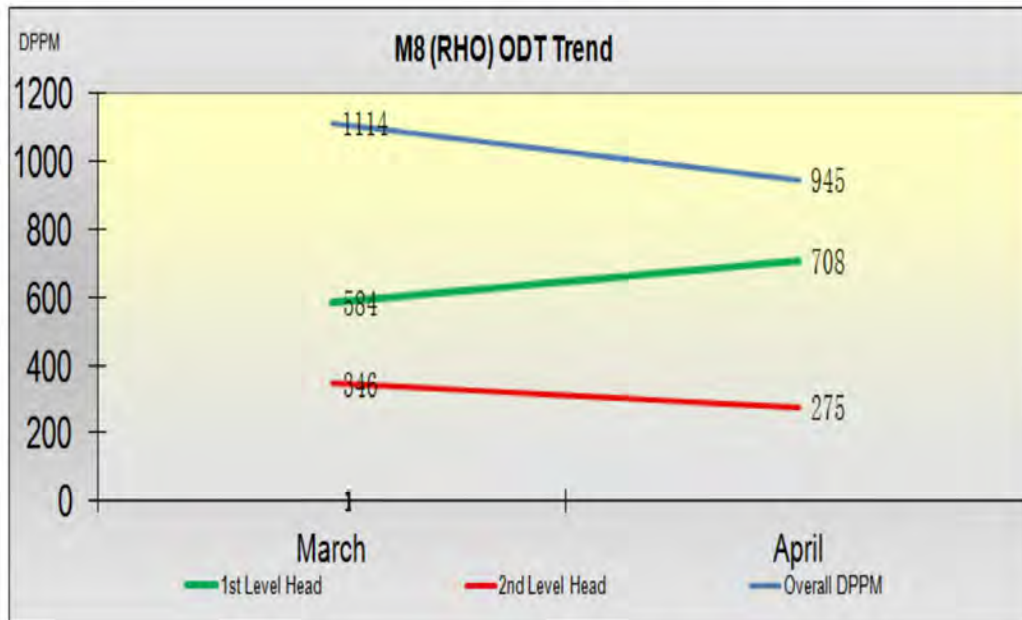
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YarraBP RHO/TDK ODT DPPM (Total) (All Sites Combined)

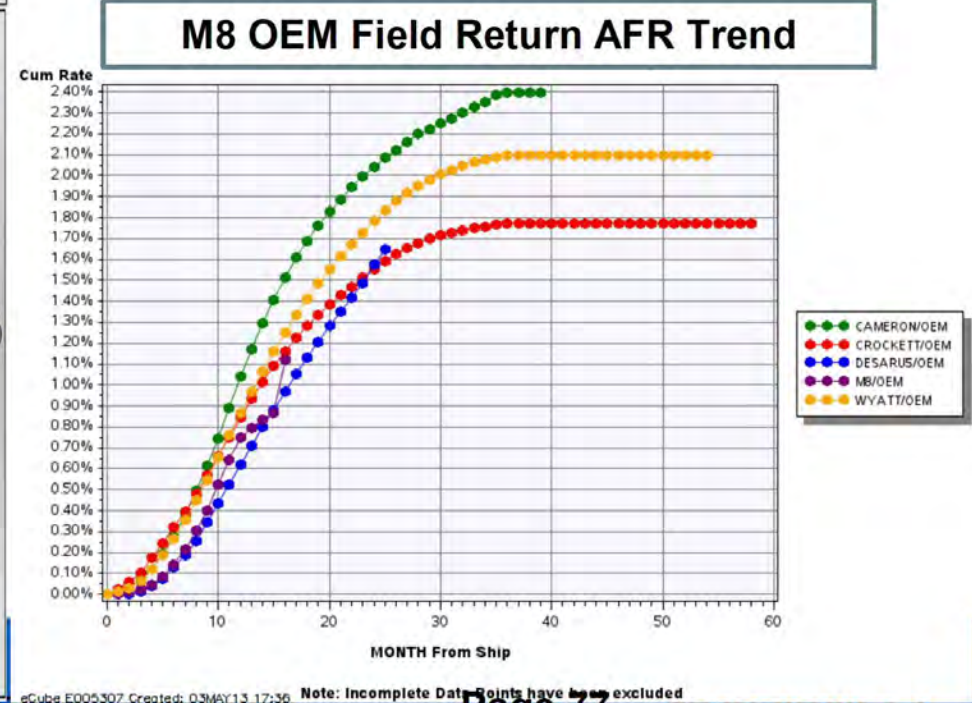
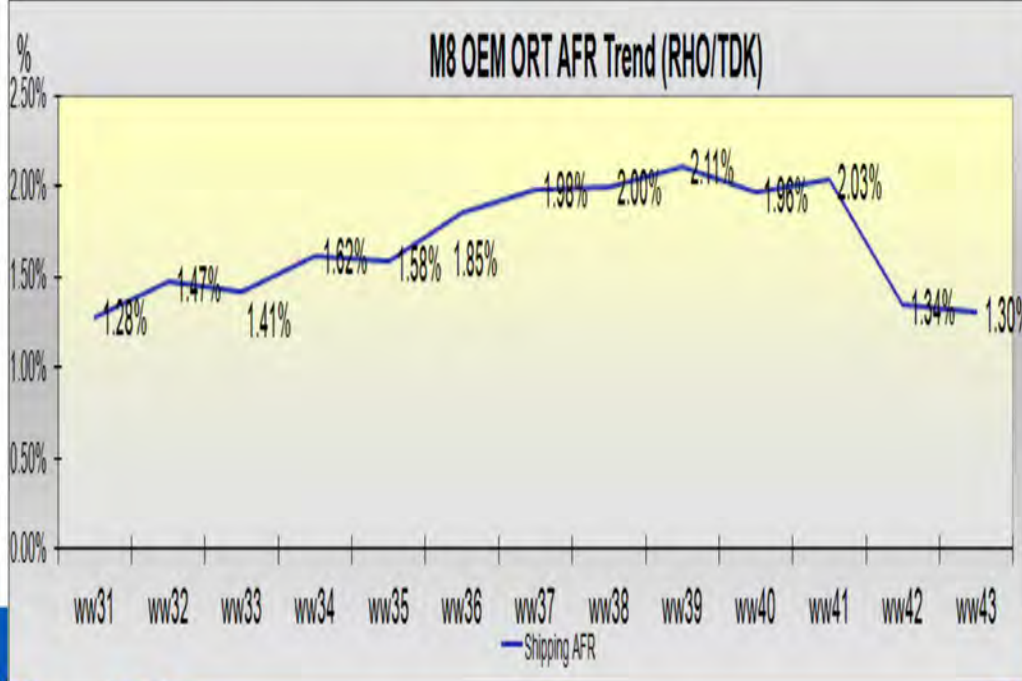


FW		Q412	Q113	Q213	Q313	April
Qty Tested (Combine)		47363	169323	141864	152024	54958
No. of Failures		77	168	112	82	23
Weekly DPPM		1626	992	789	539	419
By Vendor		Q412	Q113	Q213	Q313	April
RHO	Test Q'ty	33575	144967	110656	124647	37458
	Fail Q'ty	59	137	86	69	16
	DPPM	1757	945	777	554	427
	1st Level Head Failures	23	29	23	11	2
	1st Level Head DPPM (RHO)	685	200	208	88	53
TDK	Test Q'ty	13788	24356	31208	27377	17500
	Fail Q'ty	18	31	26	13	7
	DPPM	1305	1273	833	475	400
	1st Level Head Failures	9	13	3	5	0
	1st Level Head DPPM (TDK)	653	534	96	183	0

M8 1st/2nd Level Drive Trends (DPPM)



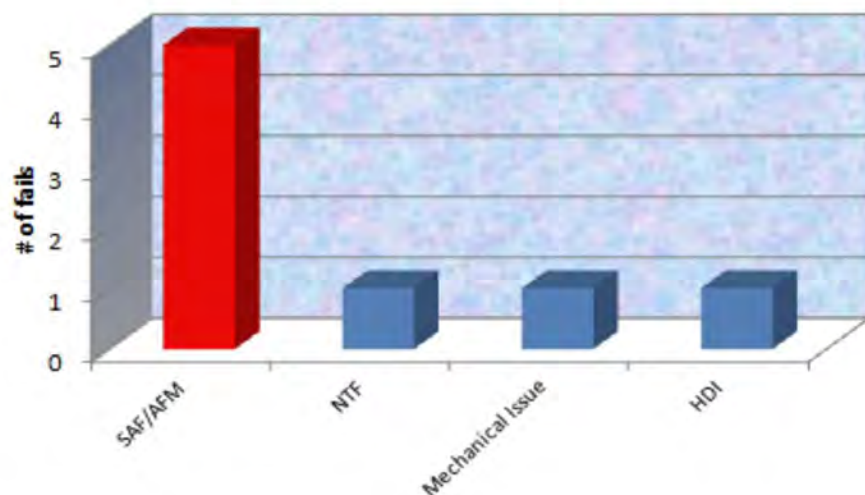
**No Customer Integration
Data
Available Yet**



M8 Head Level Pareto (DPPM)

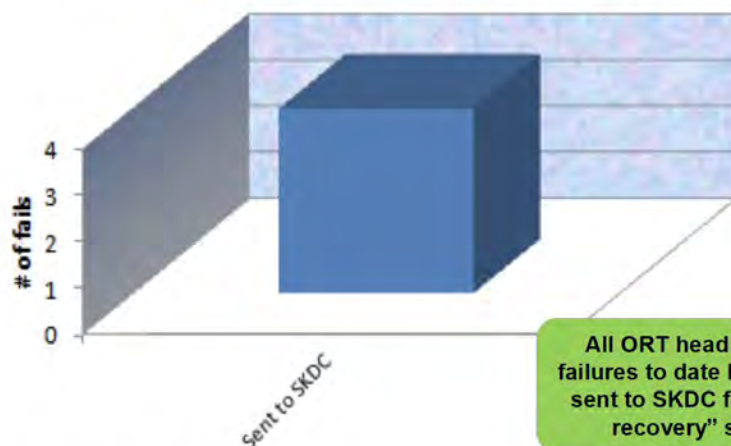
Validated via FACTS

M8 (RHO) ODT Component Level FAR
of Fails vs Type (Mar 13 - Apr 13)



**No Customer Integration
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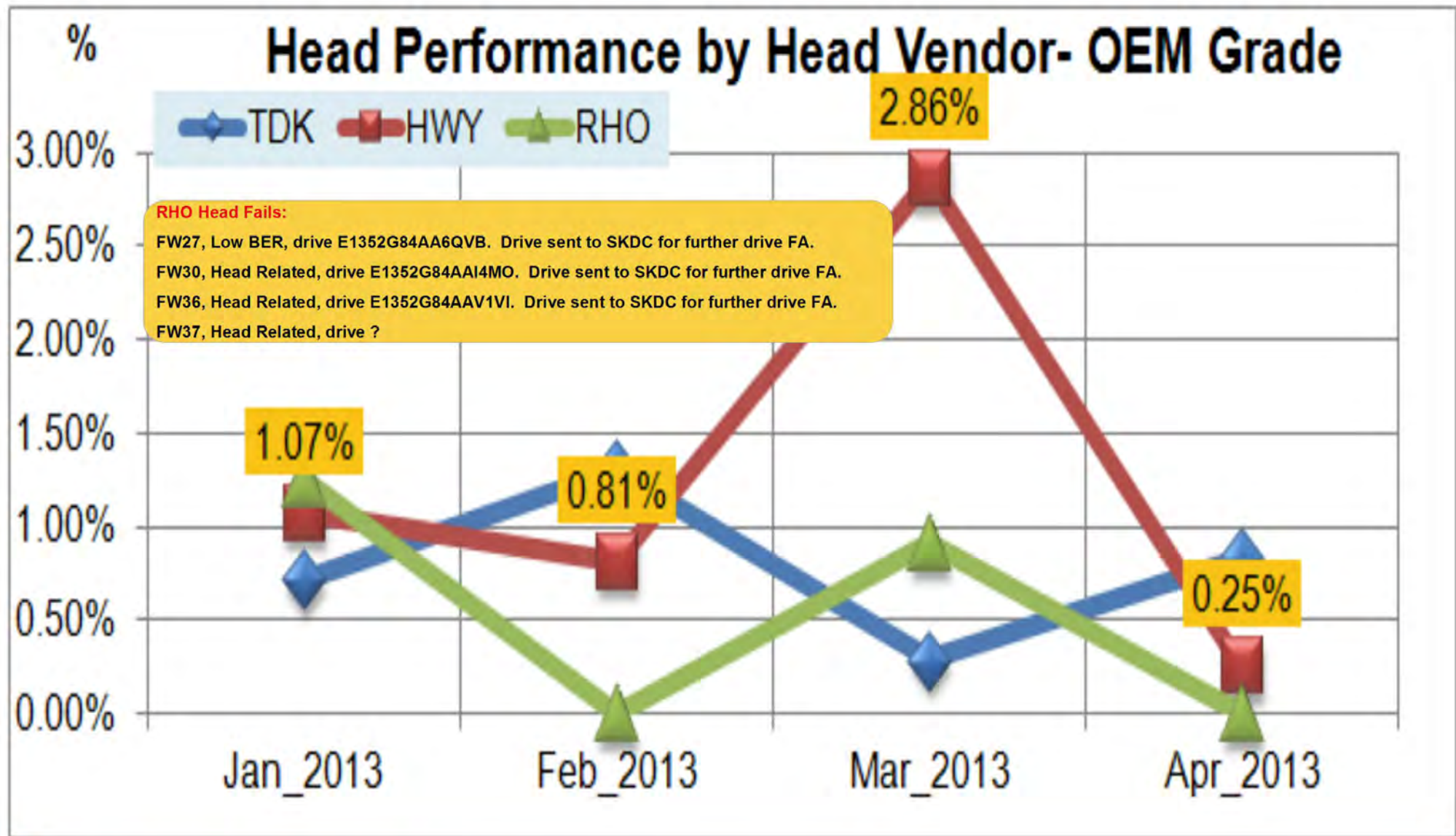
M8 (RHO) ORT Component Level FAR
of Fails vs Type (Mar 13 - Apr 13)



All ORT head related failures to date have been sent to SKDC for "drive recovery" study

**No Field Return Head
Related Data
Available Yet**

M8 ORT OEM AFR Trend - (Q413)



TDK HEAD

RHO HEAD

UNKNOWN - (NOT IN FACTS)

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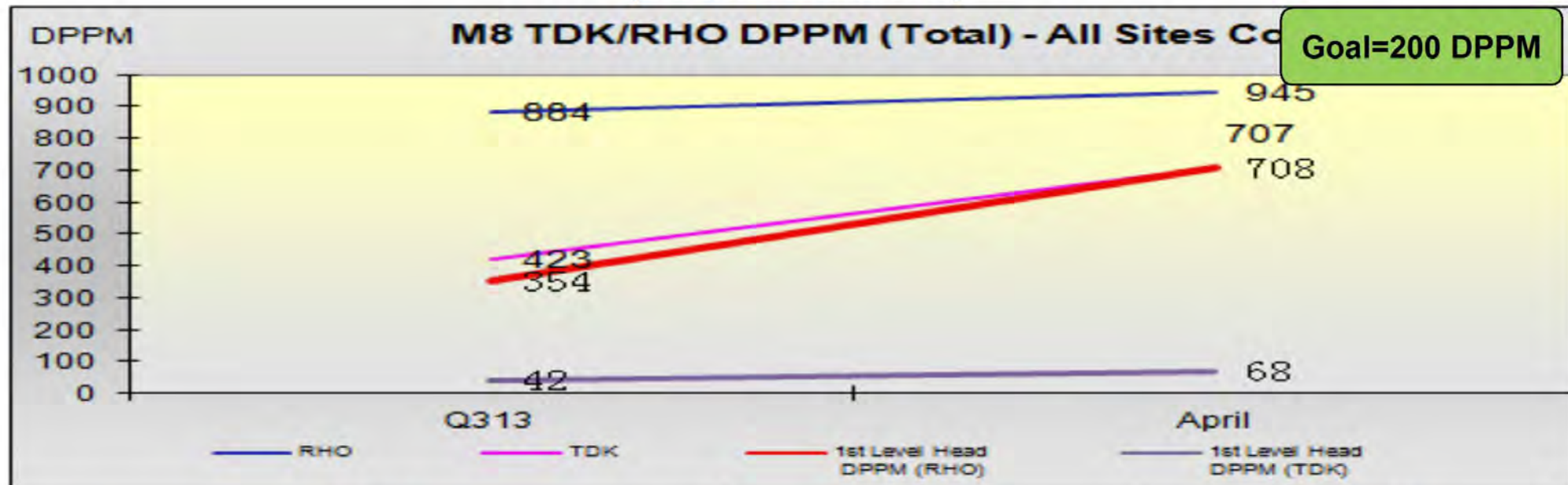
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M8 RHO/TDK ODT DPPM (Total) (All Sites Combined)



FW		Q313	April
Qty Tested (Combine)		188158	52287
No. of Failures		90	39
Weekly DPPM		478	746
By Vendor		Q313	April
RHO	Test Q'ty	22629	8470
	Fail Q'ty	20	8
	DPPM	884	945
	1st Level Head Failures	8	6
	1st Level Head DPPM (RHO)	354	708
TDK	Test Q'ty	165529	43817
	Fail Q'ty	70	31
	DPPM	423	707
	1st Level Head Failures	7	3
	1st Level Head DPPM (TDK)	42	68

FED_SEAG0056563**Metadata**

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Custodian	Zimmerman_Jason	ORIGINAL
Custodian Other	Zimmerman_Jason	ORIGINAL
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EXHIBIT 23

Grenada ORT MTBF Trigger (SSO # KOR-0187)

Thanit Suksawang
Feb 7 , 2012



Grenada Disty / OEM ORT Trigger

Background :

W31 ORT report MTBF at 107K vs 250K Disty / OEM requirement. Major failures are Degraded head (9 drives) , NMD (5 drives) and Skip write (5 drives). This impacts to Disty / OEM Native capacities , not 2TB BtC.

Observations :

- Aperio media can meet 250K MTBF. However , Grenada Aperio is planned for 10% supply only.
- Head degradations (9 drives) :
 - 5/9 can be captured with new ET combo spec and ISI spec.
 - 1/9 showed symptom of head failure on the 1st run. This require head and media replacement for EC10504.
 - 1/9 can be captured by drive parameter MAX_JUMP > 140.
- NMD (5 drives) :
 - 1/5 was with TGA reclaim. Reclaim TGA showed high failure rate at 3.9% vs Prime at 0.4-0.6%.

Impacts (total 2M drives).

- FGI : 398K (35K Korat , 94K Wuxi and 269K SuZhou).
- WIP (as of Feb 6) : 1569K (131K Korat , 335K Wuxi and 1103K SuZhou).

Supply :

- Under review.

Grenada Disty / OEM ORT Trigger

Actions :

- Issue stop ship to contain Disty / OEM Native drives all capacities at WIP and FGI / Feb 4 [Done]
- Review for paper sort criteria for drive WIP and upstream WIP
 - Paper sort criteria as of Feb 8 is accepted to release Disty and OEM drives on hold / Feb 8 [Done].
 - Total reject rate from drive and ET / ISI spec based on 1-2 sample sizes per capacity is 6% / 15% / 27% for 1TB / 2TB / 3TB (3% / 6% / 18% for drive criteria and 3% / 6% / 9% for HGA and ISI spec). Details in the backup / Feb 8 [Done].
 - Working for SBS demand to absorb Disty / OEM paper sort failures / On going
- Head degradation upstream spec tightening / Feb 9
 - Cut in a new ET combo spec / Feb 6 [Done].
 - ET yield impacted by 1.6%. Review tester impacts and on hold as a new sort and discuss usage strategy / On going.
 - Slider to cut in a new spec by Feb 9. Under PCA sign off and PG comes back from holidays.
- NMD reduction plans.
 - Review to cut in PCO17.3A (new MQM) / Feb 9.
 - JIT 3 F3 code / Feb 10 (under SIE / Reli testing).
 - New servo code / Feb 14 (under SIE / Reli testing). Require the code for factory check out by Feb 10.
 - Stop using TGA reclaim / W23 [Done]
 - Determine qualification plans for TGA reclaim both MPT and NHK / W32.
- Change ADG rules for EC10504 from B2 to B3 / Feb 6 [Done]
- Need more FA on the remaining failures / On going.
- Review ORT AFR vs Field return and pareto / On going.
- Disposition changed for 1D Alphana MBA to use for SBS only / Feb 8 [Done]
 - Working to use -303 , current 1D Alphana Disty , for SBS. No re-config required / On going

BACK UP

Frank M / Brent V / Krishnan S / Pat D

Actions from 2/6/12 Call

1. FGI degraded head screen implementation Update – Factory
2. Updated fix effectiveness with changes on Slide 4 – Reliability
3. Updated warranty reserve to reflect 154k MTBF – Reliability
4. Lenovo OEM shipment support (percent Prime + PCO 17.3A) – Factory
5. Confirmation of Alphana 1D use on SBS only – Reliability
6. Impact of Alphana 1D FGI to SBS only - Factory
7. Plan to close to SAD launch performance levels – Core Team
8. 8D on Grenada ORT SSO – Core Team
9. Long-term degraded head specification implementation – Factory
10. Inventory assessment of 20A material – Factory
11. Pharaoh ORT/Field performance vs. Grenada ORT/Field performance – Reliability

Release SSO – Korat ODT/Factory/Reliability

SSO Clearing Actions

1. FGI – apply slide 4 head screen + FE table actions on Slide 9.
2. WIP – apply slide 4 head screen + FE table actions on Slide 9.
3. New build – HGA specification (complete), Slider specification (2/9/12), PCO 17.4

Updated Summary of Changes: GOTF Changes for PCO17.4 – Feb 6

SN	PFL#	Failing Head	Symptom	ttf (hrs)	HD_SN	Proposed Screening Location	Proposed Screen(s)	Yield Impact at Location	Cut-In Date (Tentative)
S1D0HH3Y	PFL-3305	1	Head Instability	53.7	AL50BIF0V1	ET	WIJITA(15 max)+SGRNH_F3(1700 max)	0.08%	Expect STTH cut-in on Feb 7
S1F04WRR	PFL-3299	5	Head Instability	62.6	AL50MFHJL0				
W1D0C9W4	PFL-3355	1	Head Instability	295.3	AL509CQBI1				
W1D09BNP	PFL-2954	1	Degraded Head	297.2	AL507PHKJ1	ET Drive CERT	TP_NLUMP(20 max) RAW_ERROR_RATE<2.1	0.07% ~ 1%	Expect STTH cut-in on Feb 7 Paper Sort + PCO17.4
W1D0CA1T	PFL-3388	1	Degraded Head	162.3	AL50EF73X1	ISI Drive CERT	SMAN_AMP_MAX > 1700 and SMANMAX_MAX_MAX > 2100 RAW_ERROR_RATE<2.1	0.39% ~ 1%	Expect PNG cut-in by Feb 9 Paper Sort + PCO17.4
W1E04V4X	PFL-3125	1	Degraded Head	151.5	AL50PNYTH1	ET Drive CERT	TP_PLUMP(-2min) + CTQ_NORM_NSE(0.13max) RAW_ERROR_RATE<2.1	0.38% ~ 1%	Expect STTH cut-in on Feb 7 Paper Sort + PCO17.4
Z1F0C5DK	PFL-3162	5	Degraded Head	411.8	AL506GQ9J1	ET Drive ADG	TP_PLUMP(-2min) + TCO_SLN (2.2 max) Possibly prevent reCERT for EC10504 along with other potential ECs	0.23% None	Expect STTH cut-in on Feb 7 Drive PE Team working Issue
Z1F0CM95	PFL-3094	2	Degraded Head	98.7	AL50GA1IT1	Drive CERT	MAX_JUMP>140 in P135_AGC_BASELINE_JUMP for ACTIVE_HEATER=W	~ 1%	Paper Sort + PCO17.4
Z1F0ELHT	PFL-3232	1	Degraded BER	56.0	AL50I2ASZ1	Drive CERT	DELTA_BURNISH_CHECK>-5 in P_AFH_DH_BURNISH_CHECK for ACTIVE_HEATER=R and STATE_NAME+AFH3 and TEST_TYPE=BURNISH	~ 0.19% head-level drive fallout	Paper Sort + PCO17.4

- Fixed an error in the HGA ET coverage. The spec was tabled under the wrong PFL #.
- Implementation of GOTF changes for ORT degraded heads issue in PCO17.4.
 - Raw BER Spec in P_FORMAT_ZONE_ERROR_RATE.
 - Max_Jump Spec in P135_AGC_BASELINE_JUMP.
 - Burnish Spec in AFH3.
- Between all specs (ISI, ET, Drive, ADG), we have coverage on 7 failures.
- Additionally investigating a potential anomaly/interaction between VBAR and AFH in PFL-3299.
- LCO focus will shift to PCO17.4 implementation with the improvements outlined above.

ORT Fix Effectiveness

Failure Mode	FE%	Comments / Requirements
Degraded / Unstable Heads	68%	7 of 9 failures caught with Upstream + Cert specs. Spec criteria must be permanently made in a PCO and/or upstream spec
1D Alphana	100%	1D / Alphana restriction to SBS
NMD	0%	Assume no
Timeout / IOEDC Error	100%	Based upon agreement that this failure mode is not a customer issue
NMD - Reclaim TGAs	77%	Based upon Suzhou/Korat input.

154k (1.54%)

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Head Degradation failure rate analysis

SN	PFL#	Failing Head	Symptom	ttf (hrs)	HD_SN	Proposed Screening Location	Proposed Screen(s)	Yield Impact at Location	Cut-In Date (Tentative)
S1D0HH3Y	PFL-3305	1	Head Instability	53.7	AL50BIF0V1	ET	WJITA(15 max)+SGRNH_F3(1700 max)	0.08%	Expect STHH cut-in on Feb 7
S1F04WRR	PFL-3299	5	Head Instability	62.6	AL50MFHJL0				
W1D0C9W4	PFL-3355	1	Head Instability	295.3	AL509CQB1				
W1D09BNP	PFL-2954	1	Degraded Head	297.2	AL507PHKJ1	ET Drive CERT	TP_PLUMP(20 max) RAW_ERROR_RATE<2.1	0.07% ~ 1%	Expect STHH cut-in on Feb 7 Paper Sort + PCO17.4
W1D0CA1T	PFL-3388	1	Degraded Head	162.3	AL50EF73X1	ISI Drive CERT	SMAN_AMP_MAX > 1700 and SMANMAX_MAX_MAX > 2100 RAW_ERROR_RATE<2.1	0.39% ~ 1%	Expect PNG cut-in by Feb 9 Paper Sort + PCO17.4
W1E04V4X	PFL-3125	1	Degraded Head	151.5	AL50PNYTH1	ET Drive CERT	TP_PLUMP(-2min) + CTQ_NORM_NSE(0.13max) RAW_ERROR_RATE<2.1	0.38% ~ 1%	Expect STHH cut-in on Feb 7 Paper Sort + PCO17.4
Z1F0C5DK	PFL-3162	5	Degraded Head	411.8	AL506GQ9J1	ET Drive ADG	TP_PLUMP(-2min) + TCO_SLN (2.2 max) Possibly prevent reCERT for EC10504 along with other potential ECs	0.23% None	Expect STHH cut-in on Feb 7 Drive PE Team working Issue
Z1F0CM95	PFL-3094	2	Degraded Head	98.7	AL50GA1IT1	Drive CERT	MAX_JUMP>140 in P135_AGC_BASELINE_JUMP for ACTIVE_HEATER=W	~ 1%	Paper Sort + PCO17.4
Z1F0ELHT	PFL-3232	1	Degraded BER	56.0	AL501ZASZ1	Drive CERT	DELTA_BURNISH_CHECK>5 in P_AFH_DH_BURNISH_CHECK for ACTIVE_HEATER=R and STATE_NAME=AFH3 and TEST_TYPE=BURNISH	~ 0.19% head-level drive fallout	Paper Sort + PCO17.4

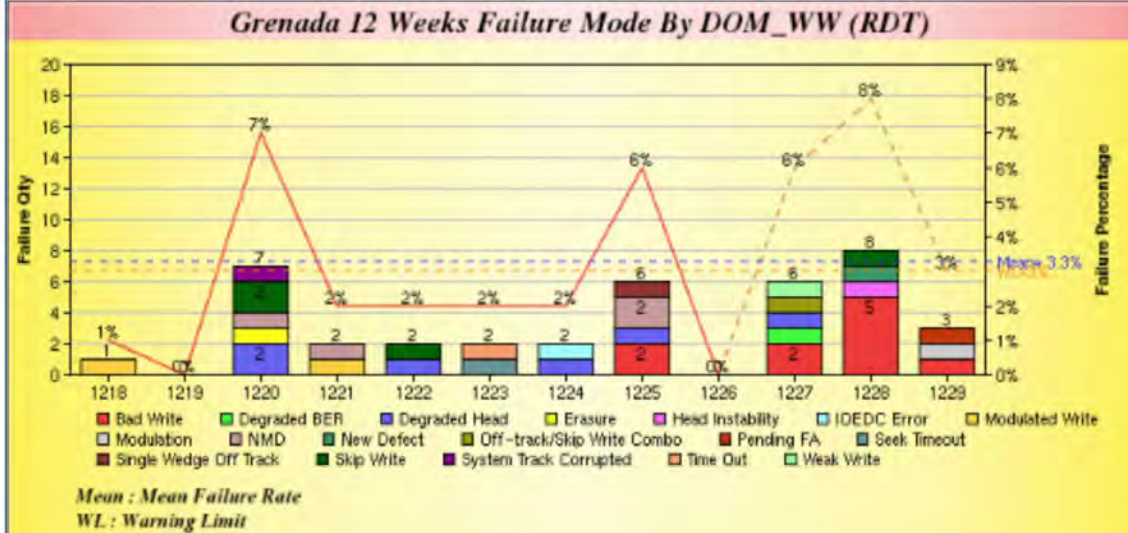
ORT 9x failure							Proposed Screen Location																
							Drive level				ET level		ISI level		Final screen level	1TB (simulation)	2TB (simulation)	3TB (simulation)					
Cap	SERIAL_NUM	PFL#	Fail_Hd	SYMPTOM	ttf(hrs)	HD_SN	Criteria	1TB %Rej	2TB %Rej	3TB %Rej	Criteria	%Rej	Criteria	%Rej		% Drive Impact	% Drive Impact	% Drive Impact					
1TB	S1D0HH3Y	PFL-3305	1	Head Instability	53.7	AL50BIF0V1					WJITA(15mas) + (V23)SGRNH_F3(1,700mas)	0.08%			HGA	0.0%	0.0%	0.4%					
1TB	W1D0C9W4	PFL-3355	1	Head Instability	295.3	AL509CQB1										-	-	-					
1TB	W1D09BNP	PFL-2954	1	Degraded Head	297.2	AL507PHKJ1	RAW_BER <2.1 (P_FORMAT_ZONE_ERR OR_RATE)	3.0%	9.0%	18%	TP_NLUMP(20mas)	0.07%			HGA	0.6%	1.6%	2.5%					
1TB	W1D0CA1T	PFL-3388	1	Degraded Head	162.3	AL50EF73X1	RAW_BER <2.1 (P_FORMAT_ZONE_ERR OR_RATE)	3.0%	9.0%	18%			SMAN_AMP_AVG > 1700 and SMAN_MAX_MAX>2100	0.39%	SLIDER	0.4%	1.5%	2.1%					
3TB	S1F04WRR	PFL-3299	5	Head Instability	62.6	AL50MFHJL0	-	-	-	-													
3TB	Z1F0C5DK	PFL-3162	5	Degraded Head	411.8	AL506GQ9J1					TP_PLUMP(-2min) + TCQ_SLN(2.2mas)	0.23%			HGA	0.2%	0.0%	0.4%					
3TB	Z1F0CM95	PFL-3094	2	Degraded Head	98.7	AL50GA1IT1	MAX_JUMP>140 in P135_AGC_BASELINE_JU MP for ACTIVE_HEATER=W	0.0%	0.1%	0.3%					DRIVE	0.0%	0.1%	0.3%					
3TB	Z1F0ELHT	PFL-3232	1	Degraded BER	56	AL501ZASZ1	DELTA_BURNISH_CHECK K < -5 (in P_AFH_DH_BURNISH_C HECK for ACTIVE_HEATER=R,STA TE_NAME= AFH3,TEST_T YPE=BURNISH)	0.9%	0.4%	1.2%					DRIVE	0.9%	0.4%	1.2%					
2TB	W1E04V4X	PFL-3125	1	Degraded Head	151.5	AL50PNYTH1	RAW_BER <2.1 (P_FORMAT_ZONE_ERR OR_RATE)	3.0%	9.0%	18%	TP_PLUMP(-2min) + CTQ_NORM_NSE(0.13mas)	0.38%			HGA	0.5%	1.8%	2.2%					
																Combine criteria		2.6%	5.4%	9.1%			
																Total Qty FNC2 passer drive		1415	2411	1040			
																** simulation from some SBR							

** simulation from some SBR

RDT issue

- Degraded Head (8x), failure rate: 0.55%
 - o Root cause: 1. Degraded Head from 20A DLC Heads; 2. Degraded Head from 22A DLC head with PCO16.2, unstable head from BP4.5/22A
 - o CA: 1. 22A DLC; AFH 35.3; AFS 8.2 New SER Spec in PCO 12.7 for the 20A Heads; 2. HMRB9.7B (25% cut in WW06); GOTF Opportunity (PCO17.4 - WW37); Upstream ISI/ET Opportunity (WW34)
 - o Cut in date: 1. 100% 22A DLC head plan to implement in DOM1231.
- NMD(5x), failure rate: 0.44%
 - o Root cause: Contamination
 - o CA: MQM Tuning (WW33); Servo code changes (WW35); Cleanliness builds results (WW36); Factory particulate cleanup (WW34)
- Bad Write(10x), failure rate: 0.83%
 - o Root cause: Bad Write due to Poor preamp precomp OPTI picks.
 - o CA: PCO17.3. Based on OEM RDT TI PFLs that have been fix validated. PCO17.3 cut in on Jan27 for all sites.

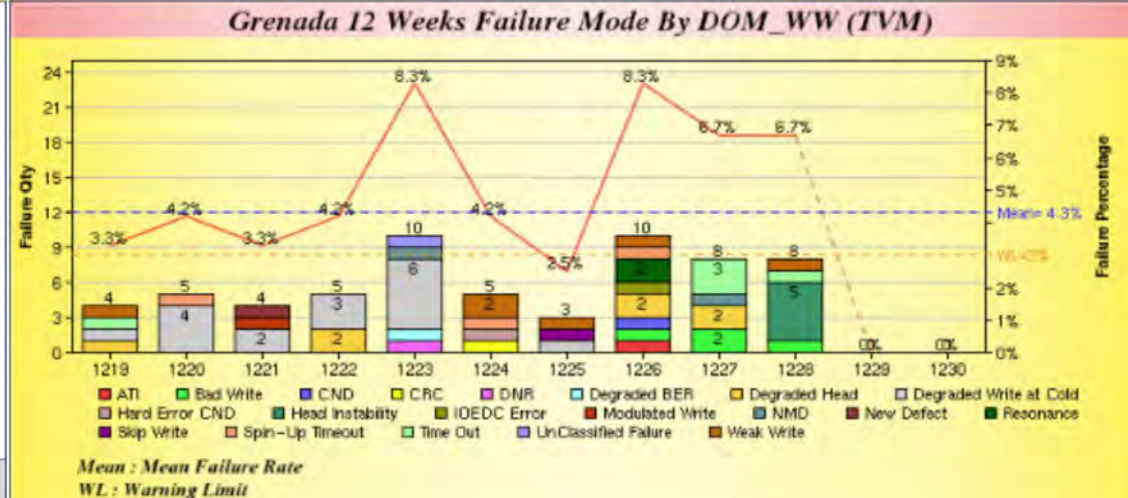
RDT Chart



TVM issue

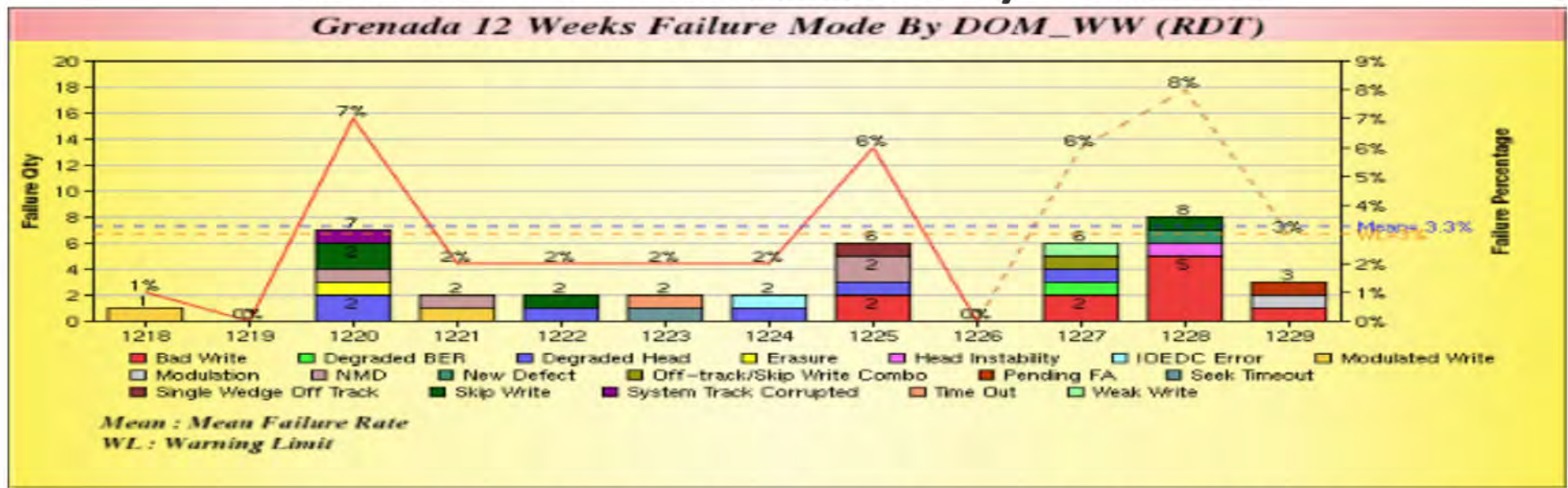
- Degraded Write at cold(17x), failure rate: 1.3%
 - o Roort cause: 1. failures from PCO12.7 found poor HMS capacity at CAL2; 2. failures with PCO16.2 under further FA
 - o CA: 1. Using VBAR by HMS in PCO16.2 to close failures with PCO12.7, some of the failures were shipped to LCO for futher FA
- Head Instability(6x) and Degraded Head(8x), failure rate: 1.0%
 - o Roort cause: Unstable head from BP4.5/22A
 - o CA: HMRB9.7B (25% cut in WW06); GOTF Opportunity (PCO17.4 - WW37); Upstream ISI/ET Opportunity (WW34)

TVM Chart



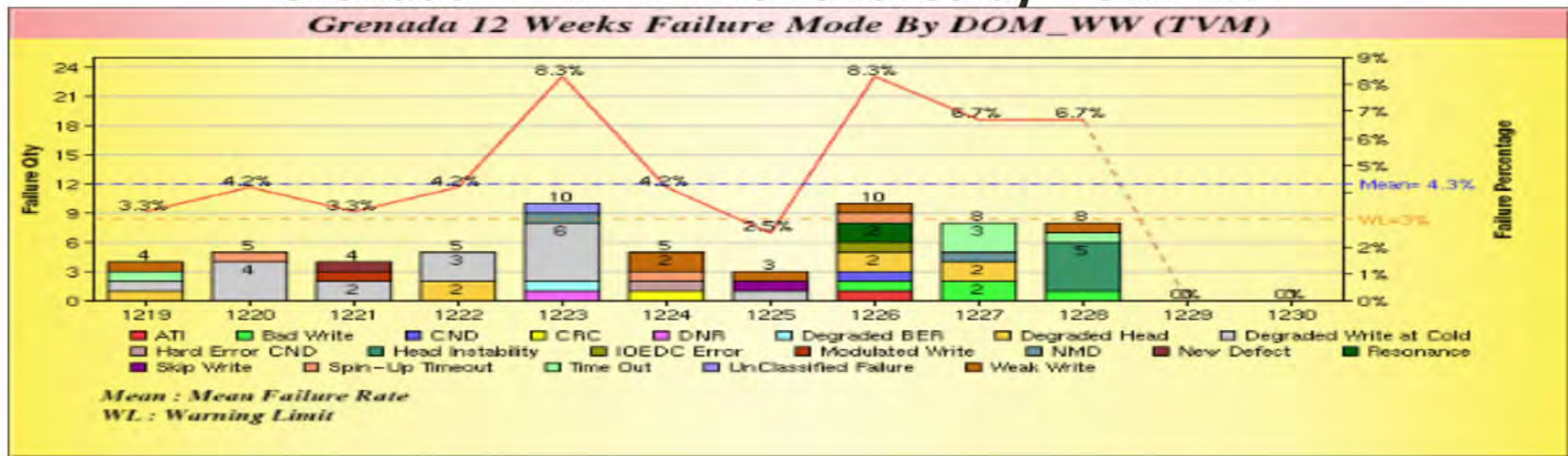
PDMT no issue

Grenada RDT 12wks Failures by DOM WW



1. RDT failure rate trigger in DOM1220, no drives in FGI and WIP when trigger, no SSO. 2x Degraded Head from 20A DLC head, CA: 22DLC head; 2xSkip Write and 1xEasure, CA: PCO17.2; 1xNMD, drive was torn down without DC mark; 1xSystem Track Corrupted FA in LCO.
2. RDT failure rate trigger in DOM1225, pending follow up. 2xBad Write due to Poor preamp precomp OPTI picks, CA: New Preamp Opti in PCO 17.3; 2xNMD, PFL-3061/3137, MSL completed, pending LCO review; 1xDegraded Head(PFL-3094), pending further FA in LCO; 1xSWOT(PFL-3297), pending further FA.
3. RDT failure rate trigger in DOM1228, pending follow up. 2xBad Write due to Poor preamp precomp OPTI picks, CA: New Preamp Opti in PCO 17.3; 1xHead Instability(PFL-3299); 1xWeak Write(PFL-3303); 1xNew Defect(PFL-3298) pending LCO Review and 1xpending 1st level FA(PFL-3365)
4. RDT failure rate trigger in DOM1227, pending follow up. 1xOff-track/Skip Write Combo, 1D Alphana, CA: 2xBad Write due to Poor preamp precomp OPTI picks, CA: New Preamp Opti in PCO 17.3; 2xDegraded Head(PFL-3232/3388), CA: HMRB9.7B (25% cut in WW06); GOTF Opportunity (PCO17.4 - WW37); Upstream ISI/ET Opportunity (WW34); 1xWeak Write(PFL-3393), drive ship to LCO for further FA on 2/3/2012.
5. RDT failure rate trigger in DOM1228, pending follow up. 5xBad Write due to Poor preamp precomp OPTI picks, CA: New Preamp Opti in PCO 17.3; 1xHead Instability(PFL-3299), CA: HMRB9.7B (25% cut in WW06); GOTF Opportunity (PCO17.4 - WW37); Upstream ISI/ET Opportunity (WW34); 1xSkip Write(PFL-3365), CA:PCO17.2+; 1xNew Defect(PFL-3298), Pending MFA and MSL.

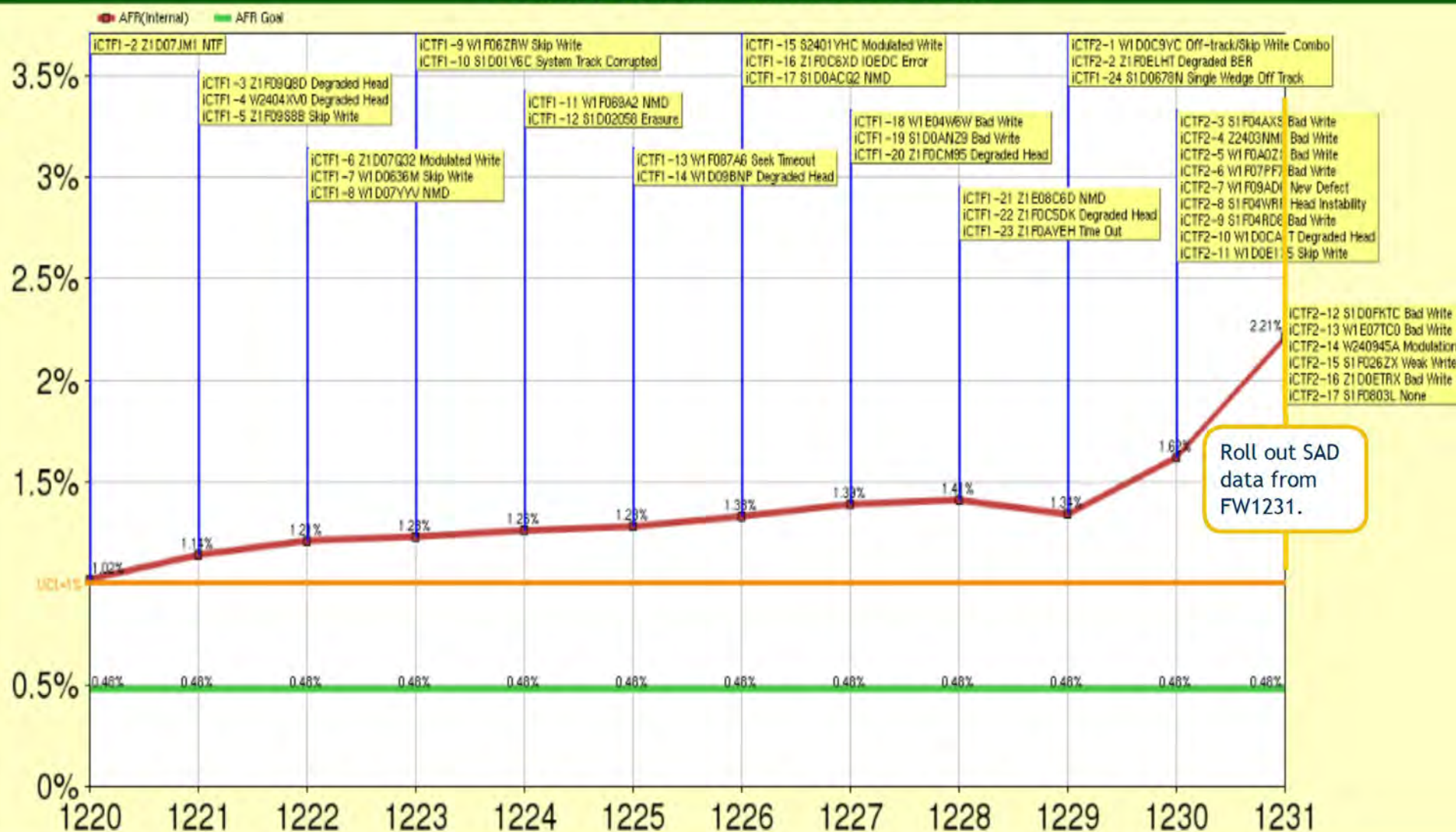
Grenada TVM 12wks Failures by DOM WW



1. TVM failure rate trigger in DOM1223 due to high failure rate of degraded Write at cold, on hold drives with PCO12.7 in FGI and WIP in all 3x sites and re-cert with PCO16.2(VBAR by HMS); PCO 17.3 with new feature TCS is designed to fix failures with PCO16.2. PCO under check out.
2. TVM failure rate trigger in DOM1226, SSO Wuxi drives of this week in FGI and WIP(WUX 0081) due to higher failure rate (11.7%, 7 failures out of 60 Wuxi drives). 1xWeak Write due to poor HMS with PCO12.7, CA: PCO16.2(VBAR by HMS); 2xBad Write due to Poor preamp precomp OPTI picks, CA: New Preamp Opti in PCO 17.3; 1xWeak Write with PCO16.2, CA: Default TCS in PCO17.3; 1xResonance, Tail tack issue See similar issue in PFL-2814, CA: on the HGA line should be driven by process team; 1xIOEDC Error retest pass; 2xCND pending to retest; 1xATI, 1/24 drive arrived in LCO for RC investigation; 1xSpin up Time Out, pending LCO servo team to do further FA.
3. TVM failure rate trigger in DOM1227, no trigger excluding Time out and Bad Write. 3xTime Out, PFL-3235/3236, pending retest/PFL-3309, pending LCO review; 2xBad Write(PFL-3267/3246) due to Poor preamp precomp OPTI picks, CA: New Preamp Opti in PCO 17.3; 1xNMD(PFL-3202), pending ship to Wuxi to teardown and get 360 degree candella; 2xDegraded Head(PFL-3241/3282), FA in LCO;
4. TVM failure rate trigger in DOM1228, pending follow up. 1xTime Out, PFL-3308, pending LCO review; 1xBad Write(PFL-3357) due to Poor preamp precomp OPTI picks, CA: New Preamp Opti in PCO 17.3; 5xHead Instalibily(PFL-3307/3358/3373/3374/3377/3378), pending LCO review; 1xWeak Write(PFL-3378)

Grenada ORT MTBF AFR: 2.21%(MTBF:107,378 hrs)

Grenada SS ORT Internal AFR Trend



MTBF based on 12 weeks' normal ORT loading , the MTBF is 107,378hrs.

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ORT – Opportunities for MTBF Improvement

- FA on unstable and degraded hga's indicates 5/9 failing heads can be caught with slider and hga spec changes. New TSR for HGA test on line by 2/7 in Korat. 2/9 for ISI spec change in Penang. Criteria can be applied for sorting WIP and FG for hga's and or drives. (criteria attached). More data on Monday 2/7, looking for any other sort criteria or cert screening data.
- Strong correlation to NMD and reclaimed TGA's. DQ'ed reclaimed TGA's effective WW23. Reli to define FE opportunity going forward with this factor removed.
- New MQM from PCO 17.3A available now. Could be implemented 2/6. NMD's occur at hours greater than MQM run time. Reli/Engr to define any FE opportunity.

ORT – Opportunities for MTBF Improvement

- FA from Feather and ORT/ODT NMD's indicate large high frequency PZT commands can occur in current code. These have been proven to create NMD. Code fix in test over the weekend. Available 2/8-10 for release. Estimate 30+% reduction in NMD's
- Strong correlation to NMD and JIT mode. JIT 0 vs JIT 3 differences under investigation by Servo team. This correlation may be effected by fixes addressed above. Evaluating opportunity for JIT3 mode in Disty until root cause is closed with JIT 0 seeks, performance data and JIT 0 characterization by 2/8-10. Estimate 30%+ reduction in NMD's.
- Particle reduction efforts in progress. Details captured in later slides. BOB builds delayed until WW35-36. Estimate 20% reduction in NMD's with numerous improvements.

ORT (RDT and ADD_RDT) TVM (approx 8 weeks)

QTY	Symptom	ORT PFLS, ttf	TVM PFL's, TTF, T
10	Bad Write	N/R	
9	Degraded heads	2954, 297 3094, 98 3162, 411 2643, 13 2664, 48 3001, 122 3000, 311 2789, 71	3182, 115 hrs, 0C 3141, 65hrs, 60C 2914, 258 hrs, 25C 2872, 173hrs, 0C
8	NMD's	2721, 4 3061, 5 3137, 222 3298, 55 2835, 439 3254, 261 3230, 9 3126, 157 3012, 399 3379, 172	3202, 8hrs, 27C 3014, 167hrs, 60C 2750, 19 hrs, 25C
5	Skip writes	N/R	3057, .8hrs, 25C 2682, 86 hrs, 0C
3	Instability	3299, 62 3305, 53 3310, 17	3307, 64hrs, 60C 3377, 190hrs, 60C 3241, 93hrs, 60C
3	Modulated Write	2663, 379 3010, 548 2814, 13	2763, 76hrs, 0C 3183, 116hrs, 0C 3135, 36hrs, 25C
15	Degraded write at cold, PCO16.x		

ORT / TVM Pareto

FA team working component analysis. RHO F/A (including upstream analysis), has consistently shown the fix to be HMRB9.7+ . Scott Deits to provide update.

FA team to provide detailed failure summary to the NMD team – head, zone, TTF, build week, suspension vendor, reclaim, prime/rework.

Skip writes improved from PCO12.6 to 16.2 (which has SWD in run-time). PCO17.3 has better tuning. CO17.3 RDT and TVM to date have no SW failures. FA team working on presenting FE data to Reli.

Instability failures are usually also degraded (changed from cert). FA team working to categorize which PFL's changed from cert.

Varity pack: tail tack (~8Khz), Alphana, 47kHz.

PCO17.4 contains THS.

Cleanliness Build Overview

Best Practices Cleanliness Builds

- **5 weeks of drive builds, 5K per week starting WW30**
 - Splitting builds 50/50 - Seagate Wuxi vs Kaifa HSAs
 - Coordinating media to be same lot and sputter machine on both Grenada and Bacall builds in each WW
 - Prime suspensions in all builds
 - Evaluating with and without short GIO (4.5 hrs TT)
- **All processes and inspection plans are documented and agreed to through FOF cleaning (details available if needed)**
 - Only open item is at HGA ET and disk usage (under discussion with RHO) –
 - » HGA ET is the point for added contamination based on line mapping
- **Expect first results WW32 from LODT (delayed 1 week)**
 - WW32 will be first results with Short GIO
- LCO Support teams headed to China End of January

First week cleanliness builds status:

- Wafer defect lost 1/3 of sliders
- Finding contamination on 1.5% (LE comb) in first batch inspections – will continue on with this weeks builds, and address in following week's batch
 - Need confirmation on Bacall material availability, Grenada material running short
- Real data after pipe cleaner builds available WW35-36!

Cleanliness builds - Changes & additional monitoring:

Slider:

- Post SCBD LE Wiping
- Post DEB 192kHz cleaning
- Post Polish 192kHz cleaning
- Soak block Polish / cleaning changes
- Additional Inspections (Visual, SeaTape, MSL)

HGA

- Additional Inspections (Visual, SeaTape, MSL)

HSA

- No Marposs
- Additional Inspections

FOF

- Long checklist of data reviews and big clean items

NMD Code improvements (Core team input)

Activity 1 - PCO17.3A (New MQM):

Feb 4 - Factory scheduled to start L-ODT demo build

Feb 8 - Finish L-ODT & publish results. If results look good, then:

Feb 9 - Mass pro cut in.

Activity 2 - JIT3 F3 code:

Feb 6 - Start SIE & Reli testing

Feb 9 - Finish SIE & Reli testing

Feb 10 - Mass pro cut in.

Activity 3 - New Servo code:

Feb 6 : Start Reli & SIE with code that looks best by monday, followed by 1 week to run, find issues, fix issues etc.

Feb 10 : we will have bench verification of either code - by Dave O LDV work & Bench signal analysis (Servo team / Abhay)

Feb 13 : Finish Reli & SIE successfully.

Feb 14 : Push to implement in masspro.

TGA Fix Effectiveness

Failure Mode	Config		Fails	Total	Failure Rate
NMD	hga_vendor	A	0	4	0.00%
		B(reclaim TGA)	1	51	1.96%
		I	2	218	0.92%
		M	0	16	0.00%
		O	0	574	0.00%
		N	2	87	2.30%
		0	0	15	0.00%
		R	0	7	0.00%
		7	0	28	0.00%

TGA subtotal from HGA vendor	Reclaim TGA(B)	1	51	1.96%
	Other TGA	4	949	0.42%

Fix Effectiveness	Sample Size	Number of Failures	Confidence Level	% Defect
	51	1	60%	3.926%
	949	4	60%	0.551%
		Fix Validation =		85.95%

Bai Tao

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List of Grenada ORT Degraded Head Failures

SN	PFL#	Failing Head	Symptom	ttf (hrs)
S1D0HH3Y	PFL-3305	1	Head Instability	53.7
S1F04WRR	PFL-3299	5	Head Instability	62.6
W1D0C9W4	PFL-3355	1	Head Instability	295.3
W1D09BNP	PFL-2954	1	Degraded Head	297.2
W1D0CA1T	PFL-3388	1	Degraded Head	162.3
W1E04V4X	PFL-3125	1	Degraded Head	151.5
Z1F0C5DK	PFL-3162	5	Degraded Head	411.8
Z1F0CM95	PFL-3094	2	Degraded Head	98.7
Z1F0ELHT	PFL-3232	1	Degraded BER	56

- 9 degraded/unstable heads in ORT have caused the MTBF to drop.
- Previously, the AFR trajectory had closely mimicked the OEM RDT trajectory, but has diverged in the last two weeks or so.

Actions being pursued:

- Detailed Configuration Analysis:
 - RHO analysis complete (Brian Mangnuson). No clear configuration trend observed.
 - RMO analysis under way (Arhsee Lumbay).
- Drive CERT Analysis:
 - LCO team working – under way (Scott Deits, Krishnan S.).
- RHO upstream Spec Analysis:
 - 1st pass complete (Joel Nathe, Song Liu). Looks promising on 5/9 failures.

Upstream Percentile Analysis (Some signatures seen in ISI testing)

	AL506GQ9J1	AL507PHKJ1	AL509CQB1	AL50BIF0V1	AL50EF73X1	AL50GA1IT1	AL50I2ASZ1	AL50MFHJL0	AL50PNYTH1
HD_SN	AL506GQ9J1	AL507PHKJ1	AL509CQB1	AL50BIF0V1	AL50EF73X1	AL50GA1IT1	AL50I2ASZ1	AL50MFHJL0	AL50PNYTH1
SN	Z1F0C5DK	W1D09BNP	W1D0C9W4	S1D0HH3Y	W1D0CA1T	Z1F0CM95	Z1F0ELHT	S1F04WRR	W1E04V4X
PFL#	PFL-3162	PFL-2954	PFL-3355	PFL-3305	PFL-3388	PFL-3094	PFL-3232	PFL-3299	PFL-3125
Failing Head	5	1	1	1	1	2	1	5	1
Symptom	Degraded Head	Degraded Head	Head Instability	Head Instability	Degraded Head	Degraded Head	Degraded BER	Head Instability	Degraded Head
tft (hrs)	411.8	297.2	295.3	53.7	162.3	98.7	56	62.6	151.5
Test Date	11/8/2011	10/25/2011	11/23/2011	11/30/2011	11/23/2011	11/19/2011	11/15/2011	11/12/2011	11/29/2011
RES	280.05	265.69	275.37	325.48	282.84	309.14	300.71	295.02	369.05
Pop_Percentile	P50-P75	P25-P50	P25-P50	P75-P90	P50-P75	P75-P90	P50-P75	P50-P75	P95-P99
AMP	17275.392	9452.229	11585.051	18257.144	10720.478	17242.674	9568.709	9710.117	9478.778
Pop_Percentile	P95-P99	P10-P25	P50-P75	P95-P99	P50-P75	P95-P99	P25-P50	P25-P50	P25-P50
ASYM	5.823	12.036	10.007	-0.058	-6.374	4.367	14.648	20.477	2.543
Pop_Percentile	P25-P50	P75-P90	P50-P75	P10-P25	P5-P10	P25-P50	P75-P90	P95-P99	P25-P50
BARK_JMP	3.244	3.436	3.157	1.608	3.573	3.502	5.814	5.383	3.93
Pop_Percentile	P25-P50	P50-P75	P25-P50	P5-P10	P50-P75	P50-P75	P75-P90	P75-P90	P50-P75
HYST_PCT	2.071	2.422	2.125	1.95	2.528	2.168	4.418	2.455	3.503
Pop_Percentile	P10-P25	P25-P50	P10-P25	P10-P25	P25-P50	P25-P50	P75-P90	P25-P50	P50-P75
MAX_SLOPE_AT	-17.955	-450.056	-529.993	-2.036	323.997	-351.961	-355.94	-18.078	-414.039
Pop_Percentile	P50-P75	P10-P25	P10-P25	P50-P75	P90-P95	P25-P50	P25-P50	P50-P75	P25-P50
MAX_SLOPE_PCT	84.023	238.539	174.285	78.867	98.949	174.017	187.694	237.798	244.93
Pop_Percentile	P10-P25	P75-P90	P50-P75	P10-P25	P25-P50	P50-P75	P50-P75	P75-P90	P75-P90
STD_MAX_SLOPE	0	0	0	0	0	0	0	0	0
Pop_Percentile	P1-P99	P1-P99	P1-P99	P1-P99	P1-P99	P1-P99	P1-P99	P1-P99	P1-P99
SMAN_AMP_AVG	385.532	494.666	380.258	398.364	1759.981	467.775	494.624	556.683	748.097
Pop_Percentile	P25-P50	P50-P75	P25-P50	P25-P50	>P99	P25-P50	P50-P75	P50-P75	P75-P90
SMAN_MAX_MAX	615.541	756.056	501.859	714.404	2135.357	432.866	638.568	691.283	1101.95
Pop_Percentile	P50-P75	P50-P75	P25-P50	P50-P75	>P99	P10-P25	P50-P75	P50-P75	P90-P95
SMAN_NORM	7.126	17.89	8.664	7.826	35.837	5.021	13.347	14.238	23.251
Pop_Percentile	P10-P25	P75-P90	P25-P50	P10-P25	>P99	<P1	P50-P75	P50-P75	P90-P95
HTR_RES	62.761	62.264	60.413	998.682	68.161	61.76	64.259	62.018	62.722
Pop_Percentile	P25-P50	P25-P50	<P1	>P99	P50-P75	P5-P10	P50-P75	P10-P25	P25-P50
SMTH_DTRND_MX_	28.35	43.628	7.018	27.693	7.58	24.704	21.844	29.249	37.429
Pop_Percentile	P75-P90	P95-P99	P1-P5	P75-P90	P1-P5	P50-P75	P50-P75	P75-P90	P90-P95
SMTH_DTRND_MX_	0.021	18.073	-13.948	60.082	-96.004	-67.974	-39.957	-18.078	-405.924
Pop_Percentile	P50-P75	P50-P75	P25-P50	P75-P90	P25-P50	P25-P50	P25-P50	P25-P50	P5-P10
MAX_STEP_PCT	-1.193	-6.017	4.551	-1.944	-2.84	-6.299	-3.63	-6.228	-5.664
Pop_Percentile	P50-P75	P5-P10	P75-P90	P50-P75	P25-P50	P5-P10	P25-P50	P5-P10	P10-P25
JUMP_CNT	0	1	0	0	0	1	0	2	0
Pop_Percentile	P1-P50	P75-P90	P1-P50	P1-P50	P1-P50	P75-P90	P1-P50	P90-P95	P1-P50
SPIKE_CNT	0	0	0	0	0	0	0	4	0
Pop_Percentile	P1-P75	P1-P75	P1-P75	P1-P75	P1-P75	P1-P75	P1-P75	P95-P99	P1-P75
BARKOMP_RMS	0.425	0.534	0.667	0.393	1.2	0.547	1.683	0.818	0.941
Pop_Percentile	P10-P25	P25-P50	P50-P75	P5-P10	P75-P90	P25-P50	P95-P99	P50-P75	P75-P90
WGHT_AVG_MX_SL	60.04	69.834	49.848	53.087	60.307	59.434	90.486	123.42	199.106
Pop_Percentile	P25-P50	P50-P75	P25-P50	P25-P50	P25-P50	P25-P50	P50-P75	P75-P90	P95-P99
JUMP_PCT_ATPK_S	1.387	1.948	2.198	1.506	2.824	2.135	4.871	4.574	3.93
Pop_Percentile	P10-P25	P25-P50	P50-P75	P25-P50	P50-P75	P50-P75	P90-P95	P75-P90	P75-P90
JUMP_PT_AT_RPS	1.524	1.314	2.833	1.052	3.233	1.411	4.714	4.641	2.365
Pop_Percentile	P25-P50	P10-P25	P50-P75	P5-P10	P50-P75	P10-P25	P75-P90	P75-P90	P50-P75
JUMP_PT_AT_RPS	0.91	1.373	2.78	1.483	2.931	1.634	3.341	1.659	2.365
Pop_Percentile	P5-P10	P25-P50	P50-P75	P25-P50	P75-P90	P25-P50	P75-P90	P25-P50	P50-P75

Current ISI FACT population has 7116654 unique heads from the 186 wafers that had test data up to 2012/02/02

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- PFL-3388 has several parameters that exhibit outlier behavior.

- Extreme outlier for SMAN noise metrics.

- Should be amenable to easy upstream screening.

- RHO/Penang Teams looking at SMAN spec yield repercussions.
 - High confidence that a spec like SMAN_AMP_AVG > 1700 can be effected quickly.

Courtesy of Joel Nathe

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Upstream Percentile Analysis (Some signatures seen in ET testing)

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Individual values vs. total Current Population			
	AL506GQ9J1	AL507PHKJ1	AL50GA1IT1
HD_SN	AL506GQ9J1	AL507PHKJ1	AL50GA1IT1
SN	Z1F0C5DK	W1D09BNP	Z1F0CM95
PFL#	PFL-3162	PFL-2954	PFL-3094
Failing Head	5	1	2
Symptom	Degraded Head	Degraded Head	Degraded Head
ttf (hrs)	411.8	297.2	98.7
Test Date	11/19/2011	11/6/2011	11/27/2011
Test Type	PRODUCTION	PRODUCTION	PRODUCTION
TSR Name	BMC6AL5P	BMC6AL5P	BMC6AL5P
TSR Num	null	45717	null
CTQ_AMP	15328.6271	8694.5689	17517.8731
Pop_Percentile	P90-P95	P25-P50	P95-P99
CTQ_ASYM	3.3131	10.2901	-4.8596
Pop_Percentile	P50-P75	P95-P99	P1-P5
CTQ_BER	-3.9487	-3.2487	-3.7058
Pop_Percentile	P25-P50	P75-P90	P50-P75
CTQ_BSLN_NSE	0.889	1.0204	0.8826
Pop_Percentile	P25-P50	P75-P90	P25-P50
CTQ_CP_CAT	100	600	100
Pop_Percentile	P1-P75	>P99	P1-P75
CTQ_CP_CLRNC	7.6881	8.2507	8.4352
Pop_Percentile	P10-P25	P25-P50	P50-P75
CTQ_HGA_ADC	0.9715	0.9632	1.0019
Pop_Percentile	P25-P50	P25-P50	P75-P90
CTQ_HTR_RES	72.7251	72.5659	70.3701
Pop_Percentile	P95-P99	P90-P95	<P1
CTQ_ISLTN	0	0	0
Pop_Percentile	P1-P50	P1-P50	P1-P50
CTQ_ISLTN_FLAG	0	0	0
Pop_Percentile	P1-P99	P1-P99	P1-P99
CTQ_LRG_GLITCH	-3.6408	-3.6408	-3.6408
Pop_Percentile	P1-P75	P1-P75	P1-P75
CTQ_MOD	3.4228	5.2978	4.0758
Pop_Percentile	P1-P5	P50-P75	P10-P25
CTQ_NORM_NSE	0.0557	0.0676	0.0429
Pop_Percentile	P25-P50	P50-P75	P5-P10
CTQ_NSE_DELTA	193.4454	27.3986	43.611
Pop_Percentile	P75-P90	P50-P75	P50-P75
CTQ_OVW	-40.6454	-31.9852	-39.1277
Pop_Percentile	P25-P50	P90-P95	P25-P50
CTQ_POL	3.2904	2.4881	4.3332
Pop_Percentile	P10-P25	<P1	P75-P90
CTQ_RD_RES	271.9942	264.685	317.0623
Pop_Percentile	P25-P50	P25-P50	P75-P90
CTQ_ROOT_YIELD	100	100	100
Pop_Percentile	>P90	>P90	>P90
CTQ_SRVO_LIN	0	1.2663	1.5837
Pop_Percentile	<P1	P10-P25	P90-P95
CTQ_WJITA	2.9198	6.9852	3.9643
Pop_Percentile	P25-P50	P90-P95	P50-P75

Individual values vs. total Current Population						
	AL509CQB11	AL50BIF0V1	AL50EF73X1	AL50I2ASZ1	AL50MFHJL0	
SN	AL509CQB11	AL50BIF0V1	AL50EF73X1	AL50I2ASZ1	AL50MFHJL0	
PFL#	W1D0C9W4	S1D0HH3Y	W1D0CA1T	Z1F0ELHT	S1F04WRR	
Failing Head	PFL-3355	PFL-3305	PFL-3388	PFL-3232	PFL-3299	
Symptom	1	1	1	1	5	
ttf (hrs)	Head Instability	Head Instability	Degraded Head	Degraded BER	Head Instability	
	295.3	53.7	162.3	56	62.6	
Test Date	12/15/2011	12/14/2011	12/15/2011	12/5/2011	12/24/2011	
Test Type	PRODUCTION	PRODUCTION	PRODUCTION	PRODUCTION	PRODUCTION	
TSR Name	BM20AL5P	BM20AL5P	BM20AL5P	BM20AL5P	BM20AL5P	
TSR Num	null	null	45844	null	null	
	CTQ_AMP	11138.9569	19667.1443	11060.0591	9347.9659	9229.119
	Pop_Percentile	P50-P75	>P99	P50-P75	P25-P50	P25-P50
	CTQ_ASYM	4.8465	-7.3379	-5.9912	5.2155	6.4179
	Pop_Percentile	P50-P75	P1-P5	P1-P5	P50-P75	P75-P90
	CTQ_BER	-3.6846	-3.4995	-4.2503	-3.8097	-3.4072
	Pop_Percentile	P50-P75	P50-P75	P5-P10	P25-P50	P75-P90
	CTQ_BSLN_NSE	1.1242	0.8037	0.8236	0.8365	1.0138
	Pop_Percentile	P95-P99	P1-P5	P5-P10	P10-P25	P75-P90
	CTQ_CP_CAT	100	100	100	100	100
	Pop_Percentile	P1-P75	P1-P75	P1-P75	P1-P75	P1-P75
	CTQ_CP_CLRNC	9.3121	6.4447	7.6632	9.0226	8.8093
	Pop_Percentile	P90-P95	<P1	P10-P25	P75-P90	P75-P90
	CTQ_HGA_ADC	1.0152	0.9999	0.9704	1.0072	0.9757
	Pop_Percentile	P95-P99	P75-P90	P25-P50	P75-P90	P25-P50
	CTQ_HTR_RES	70.9527	71.1653	74.8809	73.867	71.3238
	Pop_Percentile	P10-P25	P25-P50	>P99	>P99	P25-P50
	CTQ_ISLTN	0	0	0	0	0
	Pop_Percentile	P1-P50	P1-P50	P1-P50	P1-P50	P1-P50
	CTQ_ISLTN_FLAG	0	0	0	0	0
	Pop_Percentile	P1-P99	P1-P99	P1-P99	P1-P99	P1-P99
	CTQ_LRG_GLITCH	-3.6408	-2.4357	-3.6408	-3.6408	-3.6408
	Pop_Percentile	P75-P90	P90-P95	P75-P90	P75-P90	P75-P90
	CTQ_MOD	4.325	4.5186	6.5607	4.8086	5.7137
	Pop_Percentile	P25-P50	P25-P50	P90-P95	P25-P50	P75-P90
	CTQ_NORM_NSE	0.0533	0.0858	0.0829	0.0598	0.0962
	Pop_Percentile	P25-P50	P50-P75	P50-P75	P25-P50	P75-P90
	CTQ_NSE_DELTA	93.8405	397.1849	31.9965	-227.8628	-116.6536
	Pop_Percentile	P50-P75	P90-P95	P50-P75	P10-P25	P10-P25
	CTQ_OVW	-33.4324	-40.551	-41.9314	-36.5902	-37.8691
	Pop_Percentile	P75-P90	P25-P50	P10-P25	P50-P75	P50-P75
	CTQ_POL				3.599	
	Pop_Percentile				P25-P50	
	CTQ_RD_RES	282.7537	328.0096	287.8071	311.811	305.6733
	Pop_Percentile	P50-P75	P90-P95	P50-P75	P75-P90	P75-P90
	CTQ_ROOT_YIELD	100	100	100	100	100
	Pop_Percentile	>P90	>P90	>P90	>P90	>P90
	CTQ_SRVO_LIN	1.1239	1.3145	1.3404	1.3458	1.3933
	Pop_Percentile	<P1	P10-P25	P25-P50	P25-P50	P50-P75
	CTQ_WJITA	4.427	15.5003	3.0936	4.548	4.2761
	Pop_Percentile	P75-P90	>P99	P25-P50	P75-P90	P75-P90

• PFLs-3305, 3299, 2954, and 3232 show multiple ET signatures.

• Should be amenable to Combo Specs.

Courtesy of Joel Nathe

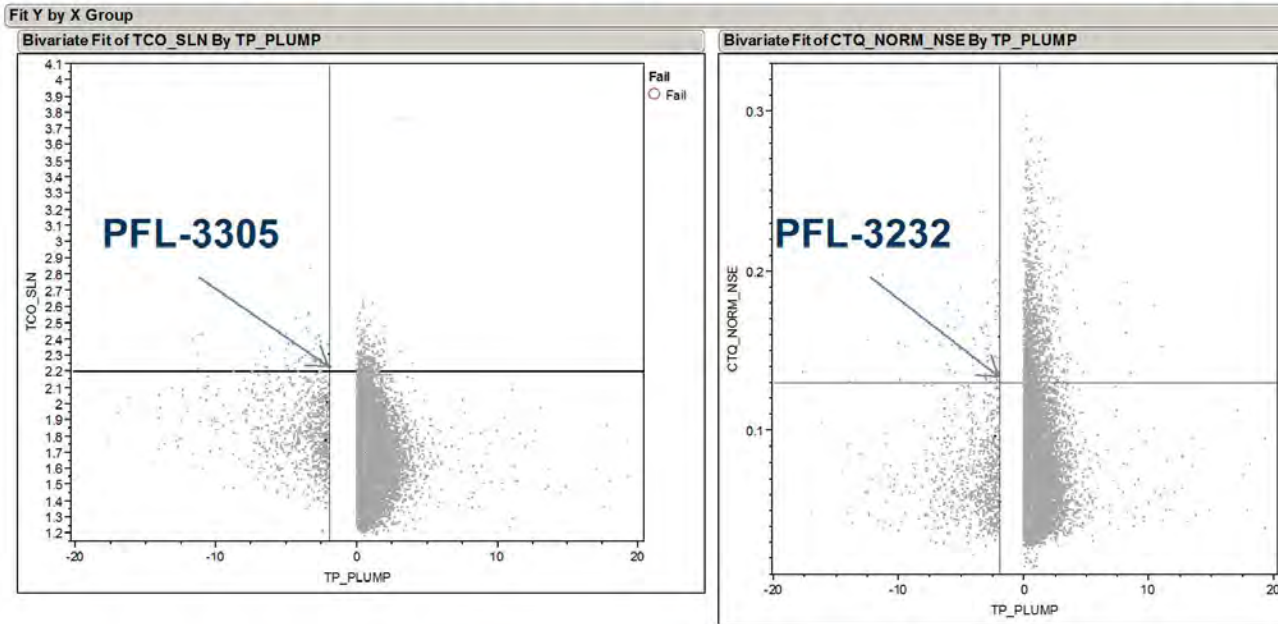
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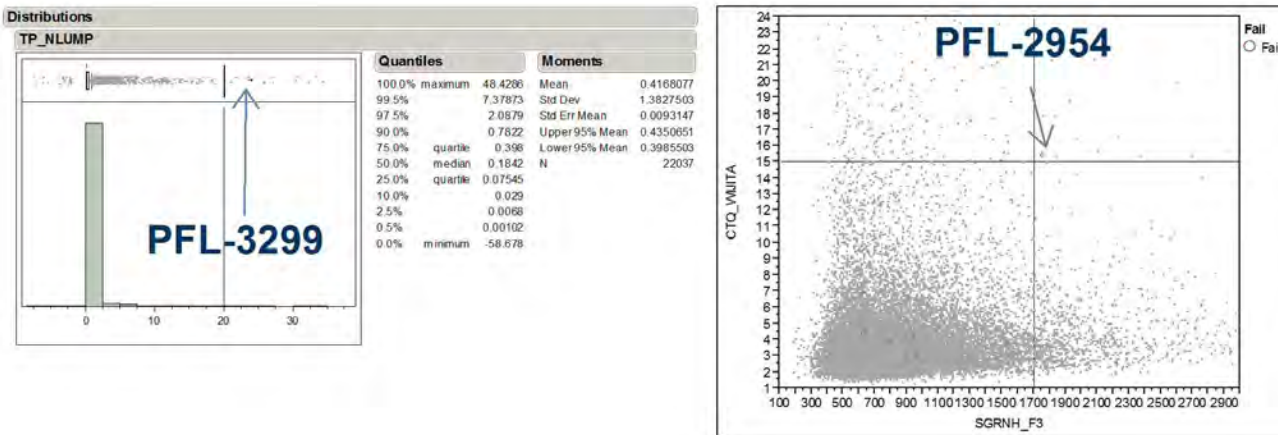
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Upstream Percentile Analysis (Some signatures seen in ET testing)

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Data and Analysis Courtesy of Song Liu



ET metrics implicated are traditional instability metrics.

- WIJITA: DC Bias Noise test. Catches instabilities well.

- Track Scan Lump metrics: Has been used to catch unstable heads on Manta Ray.

- SGR NH F3: SGRO Noise with heater enabled. A glitch metric in read-only mode.

- CTQ NORM NSE: Normalized Noise metric that usually highlights noisy heads.

Summary of ISI and ET Spec Proposals and Further Improvements planned

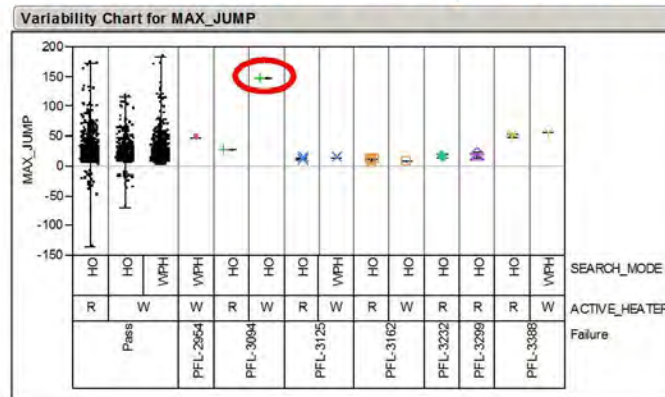
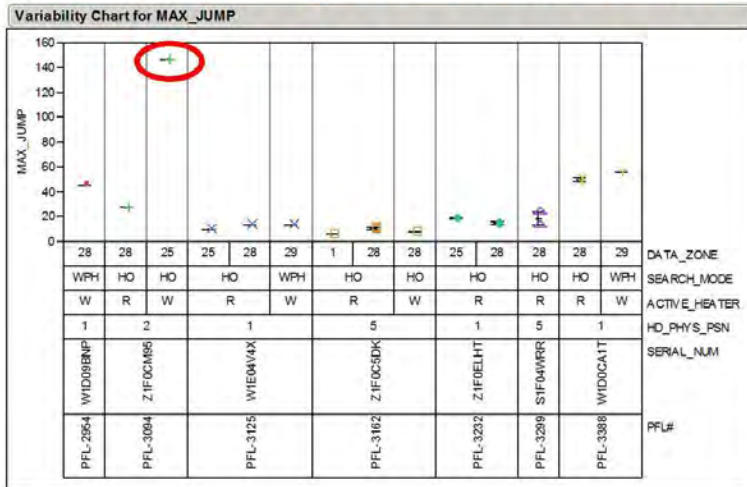
SN	PFL#	Failing Head	Symptom	ttf (hrs)	HD_SN	Proposed Screening Location	Proposed Screen	Cum ET Yield Impact	ISI Yield Impact	Cut-In Date (Tentative)
S1D0HH3Y	PFL-3305	1	Head Instability	53.7	AL50BIF0V1	ET	TP_PLUMP(-2min) + TCO_SLN (2.2 max)	0.23%		Expect STTH cut-in on Feb 7
S1F04WRR	PFL-3299	5	Head Instability	62.6	AL50MFHJL0	ET	TP_NLUMP(20 max)	0.07%		Expect STTH cut-in on Feb 7
W1D0C9W4	PFL-3355	1	Head Instability	295.3	AL509CQB11					
W1D09BNP	PFL-2954	1	Degraded Head	297.2	AL507PHKJ1	ET	WIJITA(15 max)+SGRNH_F3(1700 max)	0.08%		Expect STTH cut-in on Feb 7
W1D0CA1T	PFL-3388	1	Degraded Head	162.3	AL50EF73X1	ISI	SMAN_AMP_MAX > 1700 and SMANMAX_MAX_MAX > 2100		0.39%	Expect PNG cut-in by Feb 9
W1E04V4X	PFL-3125	1	Degraded Head	151.5	AL50PNYTH1					
Z1F0C5DK	PFL-3162	5	Degraded Head	411.8	AL506GQ9J1					
Z1F0CM95	PFL-3094	2	Degraded Head	98.7	AL50GA1IT1					
Z1F0ELHT	PFL-3232	1	Degraded BER	56.0	AL50I2ASZ1	ET	TP_PLUMP(-2min) + CTQ_NORM_NSE(0.13max)	0.38%		Expect STTH cut-in on Feb 7

Summary Table and Analysis Courtesy of Song Liu, Hoay Young Tan, Wailnn Choon

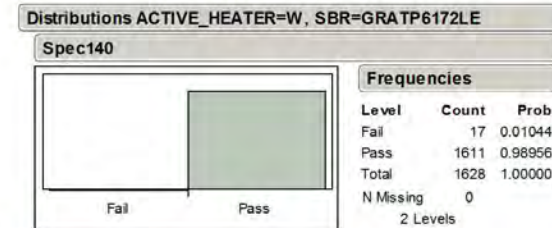
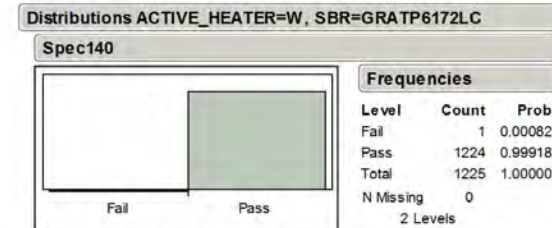
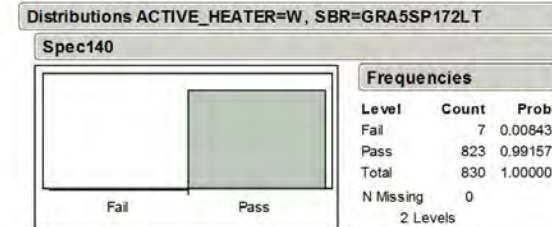
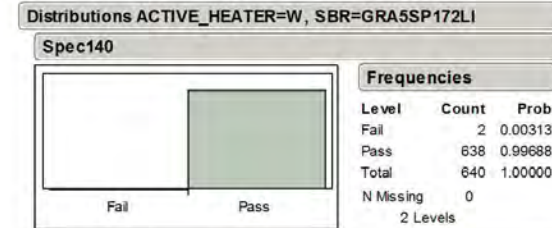
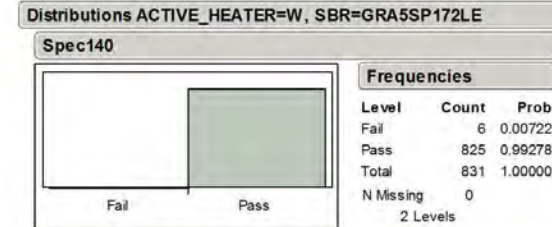
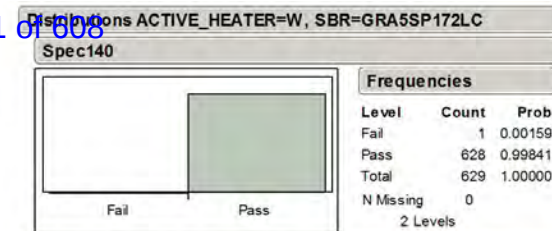
- 4/9 ORT failures have specs identified at ET that target traditional instability/noise metrics.
- Net ET Yield penalty projected to be ~ 1%.
- 1/9 ORT failures have a strong signature at ISI in slider. Head is a very significant outlier for SMAN noise metrics. Net ISI Yield penalty ~ 0.4%.
- RHO agrees to implement Slider ISI and HGA ET specs ASAP.
- New TSR request to be released by Feb 3. Expect cut-in in STTH by Feb 7.
- ISI Spec request by NRM team on Feb 6. PNG team expected to implement by Feb 9 (PNG off Feb 6-7).
- Other Degraded Head / Instability mitigation activities:
 - Heater at ISI testing: Positive Drive Results. Immediate implementation to 100% gated by H/W.
 - 20% implementation by FW31 end.
 - 70% implementation by FW35.
 - 100% implementation by FW37.
 - Continued Upstream Specs: PFLs-2907 and 3059 are being closed via upstream ET and ISI specs independently.
 - HMRB9.7B Reader Migration:
 - 11% of MBS worth of wafers will be converted to new reader starting FW32.
 - Potential for 25% wafer conversion in FW37 with lead pi-lot demonstration and RGA.
 - 100% wafer expected in FW42 (NRM and STST).
 - Drive will begin to see significant HMRB9.7B flow in FW1309.

CERT Analysis of the Failures: Baseline Jump Metric

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- May be possible to utilize Baseline Jump spec to exclude PFL-3094.
- Max BLJ of 140 during Writer Heater Search can catch PFL-3094.
- Based on PCO17.2 RGAs, Yield Loss:
 - BtC: ~ 0.7 – 1%.
 - 3TB: ~ 1%.



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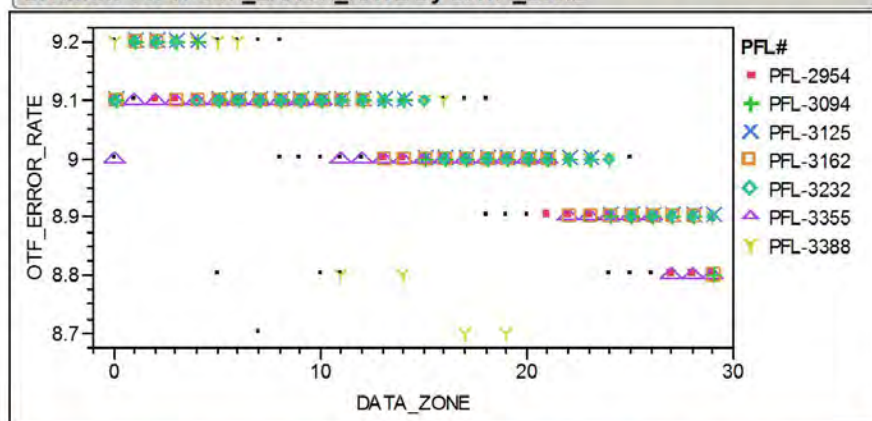
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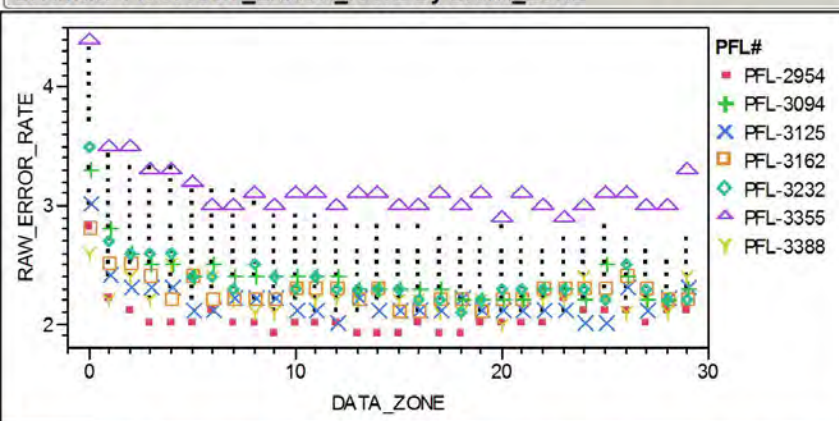
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CERT Analysis of the Failures: Raw and OTF BER in Serial Format

Bivariate Fit of OTF_ERROR_RATE By DATA_ZONE



Bivariate Fit of RAW_ERROR_RATE By DATA_ZONE



- Potential exists to remove PFL-2954 (Min Raw of 1.9 dcd), PFL-3388 (Min Raw of 2.0 dcd), and PFL-3125 (Min Raw of 2.0 dcd).
- May decide to do this ONLY for OEM (not for Disty).

PFL-3162: Degraded Head: CERT History

LAST_OP		STATUS		LAST_MOVE				FIRST_DATE						
SHP-Shipped		PASS		12/15/2011 17:11:05				12/01/2011						
PART_NUM	DESCRIP	BG	SBG	FGR	MODEL_NUM	CUSTOMER								
9YN166-300	?	MRW	GRA6S00066L	?	?	?								
PCBA	Loop	HSA	RWK	ED	FDR	CA	AH	F	AP	HP	HGP	MP	VO	
72171KWB		W218H0DKN	N	ED	FDR	CA	AH	F	AP	HP	HGP	MP	VO	
30	12/11/11 15:34	TK1B09-A			NTF	0407	NBR	C A						
29	12/11/11 15:34	TK1B09-A			NTF	0407	NB	C A						
28	12/11/11 07:32	1B06A21			CMT	PASS	NB	C A						
27	12/11/11 06:50	TK410004 [154210]			CUT2	PASS	NB	C A			R			
26	12/10/11 21:26	TK410004 [154210]			CUT2	START	NB	C A						
25	12/10/11 21:24	TK410004 [154210]			FIN2	PASS	NB	C A			R			
24	12/10/11 19:13	TK410004 [154210]			FIN2	START	NB	C A						
23	12/10/11 19:12	TK410004 [154210]			CRT2	PASS	NB	C A			R			
22	12/10/11 14:16	TK410004 [154210]			CRT2	START	NB	C A						
21	12/10/11 14:10	TK410004 [192700]			FNC2	PASS	NBR	C A			R			
20	12/07/11 04:14	TK410004 [192700]			FNC2	START	NBR	C A						
19	12/07/11 04:12	TK410004 [192700]			CAL2	PASS	NBR	C A			R			
18	12/06/11 15:57	TK410004 [192700]			CAL2	START	NBR	C A						
17	12/06/11 15:55	TK410004 [192700]			PRE2	PASS	NBR	C A			R			
16	12/06/11 02:51	TK410004 [192700]			PRE2	START	NBR	C A						
15	12/05/11 08:35	1B01B12			DBOUT	PASS	NB	C A						
14	12/05/11 08:33	TK1B51			DBG	PASS	NB	C A						
13	12/05/11 07:21	1B04A81			AWDBG	PASS	NB	C A						
12	12/05/11 04:24	TK410005 [11600]			FNC2	10504	NBP	C A			R			
11	12/02/11 15:21	TK410005 [11600]			FNC2	START	NBP	C A						
10	12/02/11 15:19	TK410005 [11600]			CAL2	PASS	NBP	C A			R			
9	12/02/11 03:52	TK410005 [11600]			CAL2	START	NBP	C A						
8	12/02/11 03:50	TK410005 [11600]			PRE2	PASS	NBP	C A			R			
7	12/01/11 15:05	TK410005 [11600]			PRE2	START	NBP	C A						
6	12/01/11 14:25	109BPS8			SCREW	PASS	NBP	C A						
5	12/01/11 14:25	1B09B13			PWA	PASS	NBP	C A						
4	12/01/11 14:19	CRX109			CRX	PASS	NBP	C A						
3	12/01/11 14:19	LRT109 [1]			LRT	PASS	NBP	C A						
2	12/01/11 14:17	ULD109			ULD	PASS	NBP	C A						
1	12/01/11 14:16	RTP021			RTP	PASS	NBP	C A						

Serial Number: Z1F0C5DK

SUBMIT

Site: Korat

5	5	21	17	25
5	5	22	17	25
5	5	23	17	25
5	5	24	17	25
5	5	25	29	25
5	5	26	31	25
5	5	27	17	25
5	5	28	29	23
5	5	29	31	26
5	5	30	28	25

P255_FIR_LSI_DATA:

HD_PHYS_PSN	HD_LGC_PSN	ZONE	TDTARGR	TMP21
5	5	0	11	155
5	5	1	10	142
5	5	2	9	141
5	5	3	11	158
5	5	4	10	144
5	5	5	9	134
5	5	6	10	142
5	5	7	9	146
5	5	8	7	125
5	5	9	10	147
5	5	10	11	154
5	5	11	11	159
5	5	12	11	161
5	5	13	11	157
5	5	14	11	158
5	5	15	11	155
5	5	16	9	142
5	5	17	10	146
5	5	18	9	136
5	5	19	9	144
5	5	20	10	156
5	5	21	9	145
5	5	22	11	156
5	5	23	11	157
5	5	24	11	156
5	5	25	11	154
5	5	26	10	145
5	5	27	9	136
5	5	28	10	149
5	5	29	10	148
5	5	30	8	125

P255_NPTARG_MISC_LSI_DATA:

HD_PHYS_PSN	HD_LGC_PSN	ZONE	TARG_TO	TARG
5	5	0	6	1
5	5	1	6	1
5	5	2	6	1
5	5	3	6	1
5	5	4	8	1
5	5	5	8	1
5	5	6	8	1

PFL-3162 was rerun after it failed CERT in the first pass for EC10504 (Too many Servo Defects).

- The head implicated in this failure is Head 5 – the failing head in Reliability.

- From FIS, it appears nothing was changed, and the drive was simply re-CERT'ed.

- Appears that the ADG rule for this code (and possibly others should be reviewed).

Detailed Analysis of PFL-3162

Case 3:16-cv-00523-JCS

Document 207

Filed 02/06/19

Page 395 of 608

P255_PRECOMP_VGA_LSI_DATA:

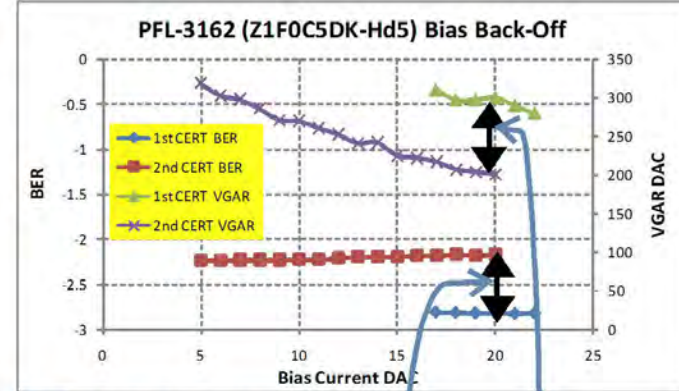
HD_PHYS_PSN	HD_LGC_PSN	ZONE	LATE0R	LATE2R	LATE0F	LATE2F	ZFR	ZFAR	CTFRNGE	CTFR	ATT2R	VGARSH	VGA_TA_LPF	ATTC_RD
5	5	0	18	18	18	18	100	72	3	3970	1	317	1	2
5	5	4	16	16	16	16	107	71	3	3743	2	294	1	1
5	5	15	17	17	17	17	109	79	3	2957	2	271	1	1
5	5	25	17	17	17	17	100	70	2	2127	2	290	0	1
5	5	29	21	21	21	21	116	60	2	1653	1	298	0	2

P255_PRECOMP_VGA_LSI_DATA:

HD_PHYS_PSN	HD_LGC_PSN	ZONE	LATE0R	LATE2R	LATE0F	LATE2F	ZFR	ZFAR	CTFRNGE	CTFR	ATT2R	VGARSH	VGA_TA_LPF	ATTC_RD
5	5	0	31	31	31	31	90	37	3	3594	1	216	1	3
5	5	4	28	28	28	28	102	42	3	3385	2	308	1	3
5	5	15	30	30	30	30	120	35	3	2807	2	303	1	3
5	5	25	30	29	30	29	125	50	2	1833	2	292	0	3
5	5	29	31	30	31	30	87	78	2	1377	1	274	0	3

P064_SRVO_FLAW_HD:

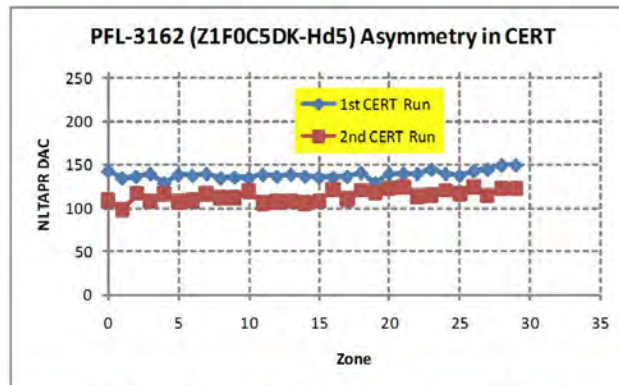
HD_PHYS_PSN	HD_LGC_PSN	RAW_SRVO_FLAW_CNT	SKIP_TRACKS	REFINED_SRVO_FLAW_CNT	HD_STATUS
0	0	0	8	0	1
1	1	0	2	0	1
2	2	0	2	0	1
3	3	0	9	0	1
4	4	0	6	0	1
5	5	140	10005	140	1



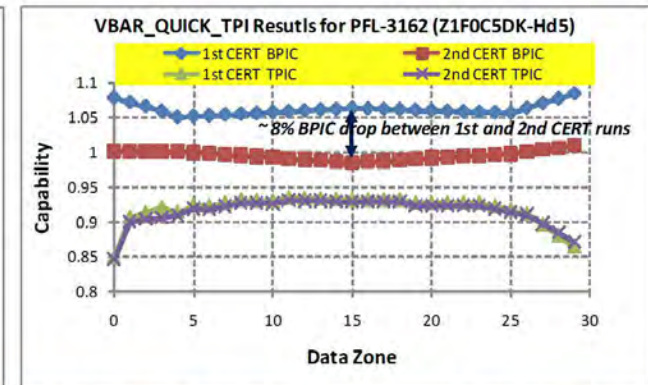
BER drop between 1st and 2nd CERT runs ~ 0.7 dcd.

VGAR drop between 1st and 2nd CERT runs ~ 80 DAC.

- Drive has significant loss in margin between 1st and 2nd CERT runs.
- In first CERT run, drive failed in FNC2 for EC10504 (too many servo defects).
- The drive was subsequently re-CERT'ed without rework.
- Clear indications of reader degradation between 1st and 2nd CERT runs.
- Increased Amplitude, Asymmetry change, and BER degradation (like bench FA) noted between 1st and 2nd CERT runs.
- Drive adaptation in 2nd CERT run very different from the 1st run and this is the reason the drive passed CERT.
- Very high likelihood that the head degraded during the 1st CERT run and continued to degrade during Reliability



Significant Reader Asymmetry change between 1st and 2nd CERT runs.



BPIC drop of ~ 8% between 1st and 2nd CERT runs.

- Corrective Action for this will need to include possibly modifying the ADG rules for this failure to include a mandatory head (and possibly

Summary of Findings

SN	PFL#	Failing Head	Symptom	ttf (hrs)	HD_SN	Proposed Screening Location	Proposed Screen(s)	Yield Impact at Location	Cut-In Date (Tentative)
S1D0HH3Y	PFL-3305	1	Head Instability	53.7	AL50BIF0V1	ET	TP_PLUMP(-2min) + TCO_SLN (2.2 max)	0.23%	Expect STTH cut-in on Feb 7
S1F04WRR	PFL-3299	5	Head Instability	62.6	AL50MFHJL0	ET	TP_NLUMP(20 max)	0.07%	Expect STTH cut-in on Feb 7
W1D0C9W4	PFL-3355	1	Head Instability	295.3	AL509CQBI1				
W1D09BNP	PFL-2954	1	Degraded Head	297.2	AL507PHKJ1	ET	WIIITA(15 max)+SGRNH_F3(1700 max)	0.08%	Expect STTH cut-in on Feb 7
W1D0CA1T	PFL-3388	1	Degraded Head	162.3	AL50EF73X1	ISI	SMAN_AMP_MAX > 1700 and SMANMAX_MAX_MAX > 2100	0.39%	Expect PNG cut-in by Feb 9
W1E04V4X	PFL-3125	1	Degraded Head	151.5	AL50PNYTH1				
Z1F0C5DK	PFL-3162	5	Degraded Head	411.8	AL506GQ9J1	Drive ADG	Possibly prevent reCERT for EC10504 along with other potential ECs	None	TBD
Z1F0CM95	PFL-3094	2	Degraded Head	98.7	AL50GA1IT1	Drive CERT	MAX_JUMP>140 in P135_AGC_BASELINE_JUMP for ACTIVE_HEATER=W	~ 1%	TBD
Z1F0ELHT	PFL-3232	1	Degraded BER	56.0	AL50I2ASZ1	ET	TP_PLUMP(-2min) + CTQ_NORM_NSE(0.13max)	0.38%	Expect STTH cut-in on Feb 7

- Coverage so far exists on 7 out of 9 failures – includes ISI, HGA ET, Drive specs, and Drive ADG rule changes.
- 3 of the failures can also be screened with a Raw BER spec in P_FORMAT_ZONE_ERROR_RATE (Fail if < 2.1).
 - Yield impact under assessment.
 - 2 of these overlap with ISI and ET spec (PFL-2954, PFL-3388).
 - PFL-3125 can additionally be caught with Raw BER spec that has no coverage elsewhere.
 - Decision will be made on Raw BER spec after CERT process is reviewed and ADG rules checked for these.
 - Potential exists for coverage of 8/9 failures.

GIO Slot Analysis

LCO process team identified five Bacall drives failed in Wuxi for EC13069(DST long failure) which also involved movement of neighboring slot during GIO

Data is limited to only five drives due to short retention of factory process data

Some slots experienced multiple neighboring tray gantry movements

Operation of failing HDD while neighboring slot tray is moved	No Movement	ATI Test @ OD	Sequential Write	Sequential Read
Number of events	3	3	1	1

- Correlation of the failures to Gemini slot interaction is not possible on the first batch as the failures bypassed FA.
- The drives were reworked and reprocessed.
- This process is a deviation from normal ODT process.
- Currently, first time LODT failures are reworked and/or processed without FA.
- Only the second LODT failure are routed to FA.
- Proper FA is essential in correlating the stressor to NMD's.

Important Note

Both ATI Test and Sequential Write are considered high write duty cycle tests.
Dither and DOS activities can be invoked frequently during these operations

NMD Code improvements (Core team input)

Activity 1 - PCO17.3A (New MQM):

Feb 4 - Factory scheduled to start L-ODT demo build

Feb 8 - Finish L-ODT & publish results. If results look good, then:

Feb 9 - Mass pro cut in.

Activity 2 - JIT3 F3 code:

Feb 6 - Start SIE & Reli testing

Feb 9 - Finish SIE & Reli testing

Feb 10 - Mass pro cut in.

Activity 3 - New Servo code:

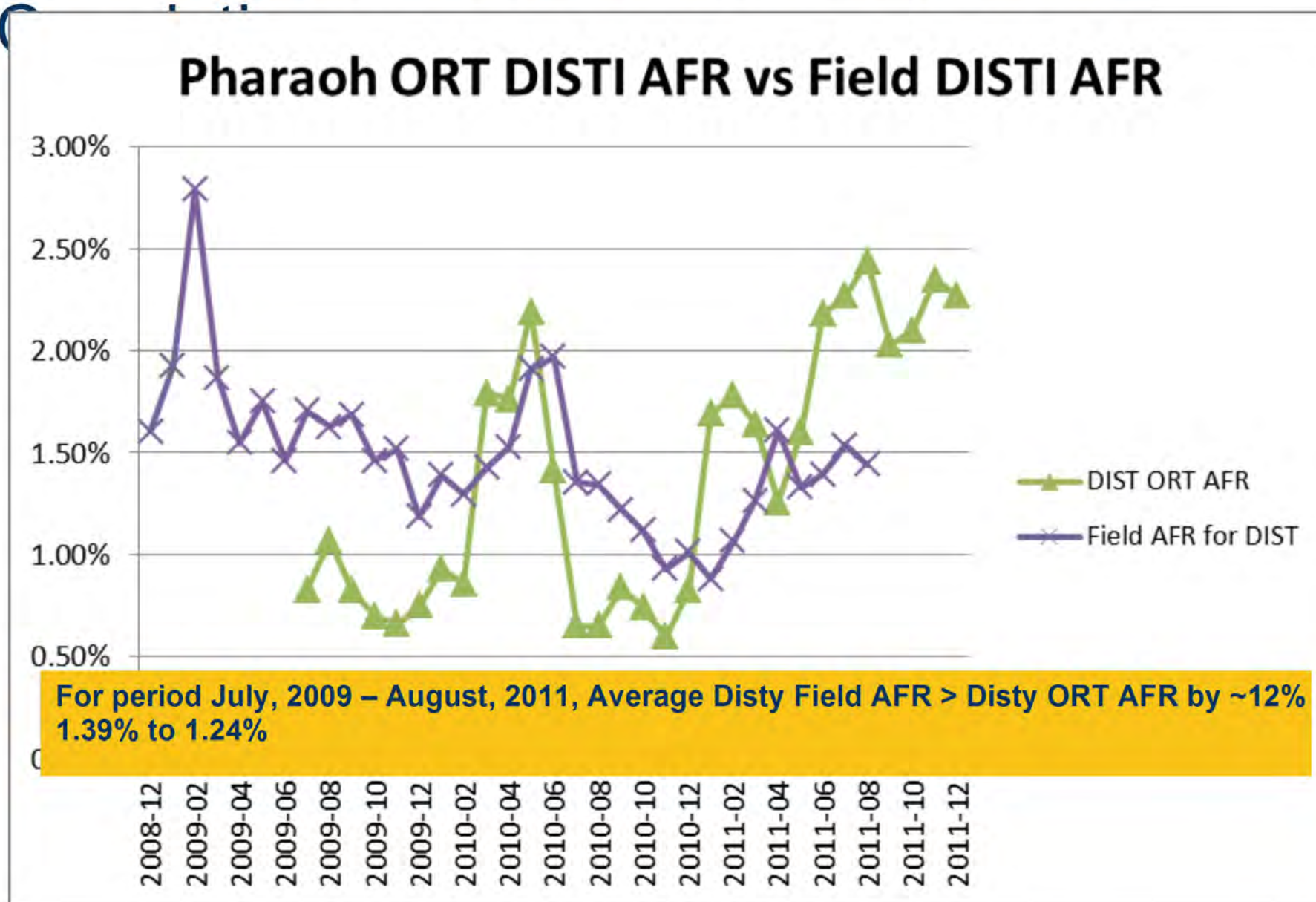
Feb 6 : Start Reli & SIE with code that looks best by Monday, followed by 1 week to run, find issues, fix issues etc.

Feb 10 : we will have bench verification of either code - by Dave O LDV work & Bench signal analysis (Servo team / Abhay)

Feb 13 : Finish Reli & SIE successfully.

Feb 14 : Push to implement in masspro.

Pharaoh ORT Dist AFR to Field AFR



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WW32 1TB OEM Shipments

9YN162-500	ACER	5,000
	BUFFALO	4,000
	DISTRIBUTION	
	LACIE	4,000
	MEDION	11,000
	TOSHIBA	5,000
9YN162-541	LENOVO	23,000

TBD pending
usage
verification

External Box
Builders @ 100k
MTBF
FGI Ship as Is.
New Build w/ 17.3A

Lenovo has no
Pharaoh 1TB
volume
Max Prime + 17.3A
Process

Many OEMs (including Acer) are buying from
channel today.

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FED_SEAG0009702

FED_SEAG0009670**Metadata**

Attach Counts	0	ORIGINAL
AUTHOR	Niki Nakada	ORIGINAL
Confidentiality	Confidential	USER
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Custodian Other	Crump_Michael	ORIGINAL
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TimeLastMod	6:19 AM	ORIGINAL
TITLE	Seagate's Corporate Teal/White Template	ORIGINAL

EXHIBIT 24

From: Thanit Suksawang <thanit.suksawang@seagate.com>
Sent: Tuesday, February 07, 2012 6:23 AM
To: Norachet Saetang; Ignatius Vun; KianFatt Chong
Cc: jeff.nygaard; Piangruetai.Sivaratana; Nuttaset Luetragul; wilson.z.zhang; YehJuang Phang; Naruepone Kaewkanjana; Thanorm Gunjeakpong; Kornsiri Karasuta; Sopon Tiamwearasakul; Manida Maneesuwan; Orapin Janprim; MeiYu C Cui; GuoPing Gui; Jerry.CC.Seh; Orawan Wiwattanajit; Duongamol Anakamane; Sudaduang Kongthongnok; Brent VanDerVliet; Pat Dewey; Gary Kelsic; Kevin D Stenvall; Michael L Cook; chanond.tesavibul; Sai S Varanasi; Glen D Almgren; Michael R Crump; Suangsuda Saengarammanojit; Sittipong Jitsiriboon; Homer Pitner; WenSan Lee-Morgan; Phil Rich; Phinyada Phuwapariyathorn; Matt Sadafi; Sandeep Bhushan; Hari H Narayan; Niran Lersnimitthum; Brijesh KU Singh; Sarun Nantavisuth; Andrew C Wong; Jariya Poonsawat; Leong Hooi Tan; KiatChoon Seow; Timothy J Peterson; Sinan Sahin; Michael L Foye; Chittiporn Pupaichitkul; Wibulporn Nilnam; Jeffrey E Mason; Frank Murphy; Sirirat Euaypadung; Panupant Viroonhamas; Soraya Dechokietawun; Aroon Tangcharoen; Boonmee Punpinit; Bunphot Phairoh; Yang.P.Pu; davis.d.chen; WaiInn Choong; WeeChuan Loh; Krishna Kumar; Yong Jiamsomporn; Wichak Phijaisanit; Ratchanee Sriwannavit; Anucha Thongbron; Supathip Umkhum; Steven C Todd; Sherry L Mutz; Sandra H Chiang; Suravadee Chatbumrungwong
Subject: Re: Fw: Grenada SHIP HOLD - Status: SHIP HOLD(--SSO # KOR-0187-00) -- ORT MTBF trigger.
Attachments: SSO-KOR-0187-00_r2.pptx

Hi,
 Grenada ORT Trigger SSO#KOR-0187 updates. More details in the attached file.

SSO is released for Disty / OEM based on

- Paper sort criteria as of Feb 8.
 - Total reject rate from drive and ET / ISI spec based on 1-2 sample sizes per capacity is 6% / 15% / 27% for 1TB / 2TB / 3TB (3% / 6% / 18% for drive criteria and 3% / 6% / 9% for HGA and ISI spec). Details in the backup / Feb 8 [Done].
 - Working for SBS demand to absorb Disty / OEM paper sort failures / On going
- Disposition changed for 1D Alphana MBA to use for SBS only / Feb 8 [Done]
 - Working to use -303 , current 1D Alphana Disty , for SBS. No re-config required / On going

On Mon, Feb 6, 2012 at 10:05 PM, Thanit Suksawang <thanit.suksawang@seagate.com> wrote:

1

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FED_SEAG0055127

Hi ,
Grenada ORT Trigger SSO#KOR-0187 updates. More details in the attached file.

Background :

W31 ORT report MTBF at 107K vs 250K Disty / OEM requirement. Major failures are Degraded head (9 drives) , NMD (5 drives) and Skip write (5 drives). This impacts to Disty / OEM Native capacities , not 2TB BtC.

Observations :

- Aperio media can meet 250K MTBF. However , Grenada Aperio is planned for 10% supply only.
- Head degradations (9 drives) :
 - 5/9 can be captured with new ET combo spec and ISI spec.
 - 1/9 showed symptom of head failure on the 1st run. This require head and media replacement for EC10504.
 - 1/9 can be captured by drive parameter MAX_JUMP > 140.
- NMD (5 drives) :
 - 1/5 was with TGA reclaim. Reclaim TGA showed high failure rate at 3.9% vs Prime at 0.4-0.6%.

Impacts (total 2M drives).

- FGI : 398K (35K Korat , 94K Wuxi and 269K SuZhou).
- WIP (as of Feb 6) : 1569K (131K Korat , 335K Wuxi and 1103K SuZhou).

Actions :

- Issue stop ship to contain Disty / OEM Native drives all capacities at WIP and FGI / Feb 4 [Done]

- Review for paper sort criteria for drive WIP and upstream WIP / Ongoing
 - A criteria proposed on Feb 6 can improve MTBF to 130K. Need additional criteria for higher MTBF.
 - Estimated 8-10% Disty fall out to be SBS. Working for SBS demand to absorb Disty / OEM paper sort failures.
- Head degradation upstream spec tightening / Feb 9
 - Cut in a new ET combo spec / Feb 6 [Done].
 - ET yield impacted by 1.6%. On hold as a new sort and discuss usage strategy / On going.
 - Slider to cut in a new spec by Feb 9. Under PCA sign off and PG comes back from holidays.
- NMD reduction plans / Feb 14
 - Review to cut in PCO17.3A (new MQM) / Feb 9.
 - JIT 3 F3 code / Feb 10 (under SIE / Reli testing).
 - New servo code / Feb 14 (under SIE / Reli testing). Require the code for factory check out by Feb 10.
- Change ADG rules for EC10504 from B2 to B3 / Feb 6 [Done]
- Stop using TGA reclaim. Need re-qualifications before resume / WW23.
- Need more FA on the remaining failures / On going.
- Review ORT AFR vs Field return and pareto / On going.

Supply :

- Under review.

----- Forwarded message -----
 From: <Brijesh.KU.Singh@seagate.com>

Date: Sat, Feb 4, 2012 at 10:21 PM


Subject: Fw: Grenada SHIP HOLD - Status: SHIP HOLD(--SSO # KOR-0187-00) -- ORT MTBF trigger.

To: Asia_Shiphold@seagate.com

Cc: Sai.S.Varanasi@webmail.seagate.com, Hari.H.Narayan@webmail.seagate.com, tao.b.bai@webmail.seagate.com

----- Forwarded by Brijesh KU Singh/Seagate on 02/04/2012 10:20 PM -----



 Double Click Here to Access the Live Document!

Title:	ORT MTBF trigger.		
ShipHold Site:	KOR, Wuxi & Sz	Status:	SHIP HOLD
Product Model #:	ST3000DM001, ST2000DM001, ST1000DM003	SH#:	KO SH-00312-00
		Ref SSO#:	KOR-0187-00
Part Number:	9YNxxx-xxx , 9YWxxx-xxx		
Date Created:	02/04/2012	Market Segment:	PSG
		VIQ:	
Revision History			
<small>Ver Date Author Description of Change</small> 00 12-Feb-04 10:00 PM Brijesh KU Singh/Seagate Initial Release			
General			
Ship Hold Approval			
Ship Hold has been Approved by:		Brijesh KU Singh	
		Date Approved: 02/04/2012	
Approver Comments:		No Comment	
Reason			
Grenada ORT MTBF is currently at 90K MTBF against spec of 250K. 2 months back RDT demonstration was at 250K MTBF. Over last 4 weeks failures are 2X. Based on current MTBF performance SSO is placed for drive build from all 3 site (Krt ,			

SZ and Wx).

The SSO is for client shipments only at following configs post DOM 25

A. 2H 1T

B. 4H 2T

C. 6H 3T

No sso for any SBS configs or CTU shipments.

Affected quantity

Site	P/N	Qty	
Wuxi	9YN162-302	14175	
	9YN162-303	900	
	9YN162-500	2950	
	9YN164-302	12400	mix of 4H/5H
	9YN166-302	61100	
	9YN166-500	2400	
	9YN16G-302	100	
	Grand Total	94025	
Suzhou	9YN162-302	35225	
	9YN162-303	26450	
	9YN162-500	7975	
	9YN164-302	37400	mix of 4H/5H
	9YN164-500	11740	
	9YN166-302	140280	
	9YN166-500	9880	
	9YN16G-302	40	
	Grand Total	268990	

Korat data under FIS crunch--Feb 05est

Clearing Action**Responsibility for Clearing:**

Hari N, Krishnan S, Thanit S, Brijesh S, Frank M, Sherwin, Wilson & Niran L.

Clearing Action:

1. FIS crunch and quarantine affected drive -- Sarun / Sherwin / HongGang -- Feb 06 est
2. Re process affected vinatage and new build drive with PCO 17.3A

3. Develop paper sort criteria for Head related failure -- Feb 07 est
4. Packout Block re claim TGA .
5. Servo code fix- Feb 10.

Locations Affected

Locations Affected:

Site Affected

Location(s) Affected: FGI, WIP

Conditional Releases

Form: SSO99 02/04/2012 10:00:14 PM

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--
Regards,
Thanit

--
Regards,
Thanit

FED_SEAG0055127

Metadata

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Attachment_Name	SSO-KOR-0187-00_r2.pptx	ORIGINAL
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Confidentiality	Confidential	USER
Custodian	Crump_Michael	ORIGINAL
Custodian Other	Crump_Michael	ORIGINAL
DATERECEIVED	2/7/2012	ORIGINAL
DATESENT	2/7/2012	ORIGINAL
DOEXT	eml	ORIGINAL
DOCTYPE	Internet Message (MIME)	ORIGINAL
FED_BEGATTACH	FED_SEAG0055127	ORIGINAL
FED_ENDATTACH	FED_SEAG0055132	ORIGINAL
FileName	Re Fw Grenada SHIP HOLD - Status SHIP HOLD(--SSO # KOR-0187-00) -- ORT MTBF trigger..eml	ORIGINAL

FILESIZE	2818343	ORIGINAL
FROM	Thanit Suksawang <thanit.suksawang@seagate.com>	ORIGINAL
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Message_ID	<CAPbS+j6JXjS9V3-iBgxDr+A9V021AGz_ktYc63S9XYcLhzciZA@mail.gmail.com>	ORIGINAL
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Relativity Native Time Zone Offset	-8.00	ORIGINAL
TIMERECEIVED	6:23 AM	ORIGINAL
TIMESENT	6:23 AM	ORIGINAL
TO	Norachet Saetang <norachet.saetang@seagate.com>; Ignatius Vun <ignatius.vun@seagate.com>; KianFatt Chong <kianfatt.chong@seagate.com>	ORIGINAL

EXHIBIT 27

From: John D Grieci <john.d.grieci@seagate.com>
Subject: Re: 8D Grenada OEM & Disti ORT TVM DOM WW1251 Trigger (SSO# 0216)_Update_Jul11
To: Sai S Varanasi <sai.s.varanasi@seagate.com>
Cc: Michael Crump <Michael.R.Crump@seagate.com>, KianFatt Chong <kianfatt.chong@seagate.com>, Pianguetai Sivaratana <pianguetai.sivaratana@seagate.com>, Hari H Narayan <hari.h.narayan@seagate.com>, Jeffrey E Mason <jeffrey.e.mason@seagate.com>, Mark E Re <mark.e.re@seagate.com>, Jeff Nygaard <jeff.nygaard@seagate.com>, Frank Murphy <Frank.Murphy@seagate.com>, Alan B Johnston <alan.b.johnston@seagate.com>, Jeffrey K LaCroix <jeffrey.k.lacroix@seagate.com>

These failure rates are extremely high for single cause:

d. Instability failure rate for Key OEM = 0.49%, Std OEM= 0.70% and Disty = 1.7%

On Thu, Jul 12, 2012 at 5:40 PM, Sai S Varanasi <sai.s.varanasi@seagate.com> wrote:

John,

As we discussed this particular trigger in TVM seems to be related to particle contamination. FA is underway.

At a higher level, Grenada triggers are mainly due to head instability and particle related issues.

Instability:

a. We identified head instability issue with the first SSO in dec/jan. As a company we made a decision to use the 'bad' wafer/slider material to meet Q3/Q4 volumes. We expected to finish using this material in middle of Q4, however we will continue to consume until WW17 (via disty/SBS config). To improve OEM performance we are using non-SLT-05 for OEMs.

b. To further improve OEM performance we have tighter OEM cert specs. I suspect this is another reason why OEM performance in ORT is improving but Disty is not (even with non-SLT05 material).

c. Work is underway to understand additional stress in Grenada drive that might be increasing this failure rate.

d. Instability failure rate for Key OEM = 0.49%, Std OEM= 0.70% and Disty = 1.7%

Particles:

a. NHK failure rate continues to be 3-4X higher than MPT. Starting this week we should have much higher mix of MPT in OEM (and hence increasing NHK ratio into Disty).

b. In addition to NHK, we also have other normal particle contam contributors (Talc, Slider particles, SST, AIO etc).

OEM ORT raw failure rate (starting to improving....)

Disty ORT raw failure rate (not improving.....ignore last two weeks because runtime is short)

Thanks

Sai

China# 18662271002

US# 303 913 9309

----- Forwarded message -----

From: **John D Grieci** <john.d.grieci@seagate.com>

Date: Thu, Jul 12, 2012 at 6:26 AM

Subject: Re: 8D Grenada OEM & Disti ORT TVM DOM WW1251 Trigger (SSO# 0216)_Update_Jul11

To: Chanond Tesavibul <chanond.tesavibul@seagate.com>

Cc: Michael R Crump <Michael.R.Crump@seagate.com>, Hari H Narayan <hari.h.narayan@seagate.com>, Sai S Varanasi <sai.s.varanasi@seagate.com>, "wilson.z.zhang" <wilson.z.zhang@seagate.com>, YehJuang Phang <yehjuang.phang@seagate.com>, Yan Liao <yan.liao@seagate.com>, Run Zhang <run.zhang@seagate.com>, Jun Huang <jun.huang@seagate.com>, Leong Hooi Tan <leonghooi.tan@seagate.com>, JunDui L Lu <JunDui.L.Lu@seagate.com>, Ke X Xu <ke.x.xu@seagate.com>, KokChiang Lau <kokchiang.lau@seagate.com>, KiatChoon Seow <kiatchoon.seow@seagate.com>, "Piangruetai.Sivaratana" <Piangruetai.Sivaratana@seagate.com>, Nuttaset Luetragul <nuttaset.luetragul@seagate.com>, MeiYu C Cui <meiyu.c.cui@seagate.com>, GuoPing Gui <guoping.gui@seagate.com>, "Jerry.CC.SeH" <Jerry.CC.SeH@seagate.com>, Suangsuda Saengarammanojit <suangsuda.saengarammanojit@seagate.com>, Niran Lersnimitthum <Niran.Lersnimitthum@seagate.com>, Chittiporn Pupaichitkul <chittiporn.pupaichitkul@seagate.com>, Wibulporn Nilnam <wibulporn.nilnam@seagate.com>, Jimmy S Sin <jimmy.s.sin@seagate.com>, Pat Dewey <pat.dewey@seagate.com>, Brent VanDerVliet <Brent.VanDerVliet@seagate.com>, Timothy J Peterson <timothy.j.peterson@seagate.com>, Michael L Foye <michael.l.foye@seagate.com>, Sittipong Jitsiriboon <sittipong.jitsiriboon@seagate.com>, Gary Kelsic <Gary.F.Kelsic@seagate.com>, Michael L Cook <michael.l.cook@seagate.com>, Kevin D Stenvall <kevin.d.stenvall@seagate.com>, Phinyada Phuwapariyathorn <phinyada.phuwapariyathorn@seagate.com>, Donald G Smith <donald.g.smith@seagate.com>, Matt Sadafi <matt.sadafi@seagate.com>, Krishnan Subramanian <Krishnan.Subramanian@seagate.com>, Glen D Almgren <glen.d.almgren@seagate.com>, Frank Murphy <frank.murphy@seagate.com>, Tao Bai <tao.b.bai@seagate.com>, Qian G Gu <qian.g.gu@seagate.com>, Jariya Poonsawat <jariya.poonsawat@seagate.com>, Oran Kuskul <Oran.Kuskul@seagate.com>, Chris G Labbe <chris.g.labbe@seagate.com>, Duongamol Anakamancee <Duongamol.Anakamancee@seagate.com>, Orawan Wiwattanajit <orawan.wiwattanajit@seagate.com>, Sarun Nantavisuth

<sarun.nantavisuth@seagate.com>, Wasana Ruamsup
<wasana.ruamsup@seagate.com>, Jeffrey E Mason <jeffrey.e.mason@seagate.com>

Folks,

What are we doing here with Granada? We seem to trigger often. We shipped 145K drives and we are holding 31K drives to screen I guess? This makes no sense!!! We are not managing quality here, we are just shipping product that will bite us later.

We NEED a longer term plan here. This drive does not seem like a good drive and feels a lot like Compass??

Can we get a plan here on what we are going to do and should we stop shipping the drive altogether until we have identified the root cause?

Do we need to get on the phone to discuss?? I get really nervous when we have 5 failures out of 60 drives??

Please let me know!

John

On Thu, Jul 12, 2012 at 12:19 AM, Chanond Tesavibul
<chanond.tesavibul@seagate.com> wrote:

Mike,

Please see the update in Blue

A: Product / Problem (Issue)

Grenada OEM and Disty DOM1251 TVM test detected 5 failures out of 60 drives tested, the failure rate is 8.3% which is higher than trigger limit at 3%.

Failures mode are: 3x Modulation, 1x Degraded Head and 1x NMD.

Factory quality agree upon CEE and FPT team to quarantine drives from DOM1251 all 3 sites (Korat, Wuxi and Suzhou) residing in FGI and WIP to be quarantined for treatment.

B: 8D Driver & 8D Owner(s)/Org

8D Owner: Piangruetai (Ops)
 8D Quality Lead: Chanond T.

C: Drives Impacted (Cus-Tab)

Total affected quantity = 176761 drives.

Quantity at FGI = 31,211 drives

Quantity in WIP = 143 drives. (Pending addition form SuZhou and Wuxi)

Quantity shipped to customer = 145,407 drives. (Pending addition form Wuxi)

ORT	Korat	SuZhou	Wuxi	Total
WIP	143	1331	160	1643
FGI	3336	20515	7360	31211
Ship	23477	121930	86589	231996
Total	26956	143776	94109	264841

D: Drives In Field/Hubs

231,996 drives

E: Summary & Status

Affected Drive quarantined, WIP and FGI pending for Paper sort and assessment.
 WW1302

Paper sort criteria already provided and released by product engineering.
 Jul 07,2012

The paper sort screening criteria are:

(1). From Table "P_TCS_ZN_SUMMARY" at CRT2 operation, Fail if: 'Max(TCS)' > 0.35 <== Max 'TCS' on each drive

(2). From Table "P109_UNSAFE_SUMMARY" at FNC2 operation, Fail if 'Max(Max(FVGA_ERR_CNT))' > 540

Base on these 2 criteria, screening can capture 3/5 failures (2x Modulation and 1x Head

Degraded) which 5.6% got screened out.

F: Root Cause

FA under finding the real root cause.

G: Containment

1. FIS crunch and quarantined affected drives in FGI, Stop pack has been created. 3sites QA / Process. -- Jul 06 Done
2. Provide Affected drives screening criteria Jul 06 Done PE / Wibulporn N. --
3. Paper sort affected vintage drives. -- WW1302 / On going Process / MFG
4. 7days Reliability test assessment. Reliability -- WW1302 / On going Process /
5. Review assessment result. -- TBD Reliability

H: Customer Communication

No,

I: Next Steps

Follow up CAPA and validation fix effectiveness.

Regards,
Chanond

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SeaTel : 8-470-3509

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FED_SEAG0060976**Metadata**

Attach Counts	0	ORIGINAL
CC	Michael Crump <Michael.R.Crump@seagate.com>;KianFatt Chong <kianfatt.chong@seagate.com>;Piangruetai Sivaratana <piangruetai.sivaratana@seagate.com>;Hari H Narayan <hari.h.narayan@seagate.com>;Jeffrey E Mason <jeffrey.e.mason@seagate.com>;Mark E Re <mark.e.re@seagate.com>;Jeff Nygaard <jeff.nygaard@seagate.com>;Frank Murphy <Frank.Murphy@seagate.com>;Alan B Johnston <alan.b.johnston@seagate.com>;Jeffrey K LaCroix <jeffrey.k.lacroix@seagate.com>	ORIGINAL
Custodian	Crump_Michael	ORIGINAL
Custodian Other	Crump_Michael	ORIGINAL
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DATESENT	7/13/2012	ORIGINAL
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FED_ENDATTACH	FED_SEAG0060982	ORIGINAL
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FILESIZE	53245	ORIGINAL
FROM	John D Grieci <john.d.grieci@seagate.com>	ORIGINAL
MD5 Hash	9C507FEB799ACA5AC4B34489883FD22	ORIGINAL
Message_ID	<CAMVg--nepNN_0K+zgENWn9Gxu=sZCHxKKx_twz28q+nbPjaV3w@mail.gmail.com>	ORIGINAL
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Relativity Image Count	7	ORIGINAL
Relativity Native Time Zone Offset	-8.00	ORIGINAL
TIMERECEIVED	6:44 AM	ORIGINAL
TIMESENT	6:43 AM	ORIGINAL
TO	Sai S Varanasi <sai.s.varanasi@seagate.com>	ORIGINAL

EXHIBIT 29

From: "SSO System" <SockAi.Lim@seagate.com>
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 <LiangSin.Siew@seagate.com>,<YehJuang.Phang@seagate.com>,
 <Run.Zhang@seagate.com>,<Yan.Liao@seagate.com>,
 <JianGuo.Xu@seagate.com>,<Tony.EG.Lim@seagate.com>,
 <xingjun.w.wang@seagate.com>,<Joanne.B.Ward@seagate.com>,<Ketruthai.Polachan@seagate.com>
Subject: SSO System - Daily Summary Report

** This is an automatic message from Web SSO System. Please DO NOT reply to this system generated email. **

Below is the SSO daily summary report.

1. SSO Newly Created

SSO_NUM	PRODUCT	CREATOR	REASON
<u>TTK-005317</u>	GRENADA	Chanita Kerdrit	Hold for Special Build
<u>TTK-005318</u>	GRENADA	Chanita Kerdrit	Hold for Special Build
<u>TTK-005319</u>	GRENADA	Somprasert Kitiwiriyaikul	Slider_Contamination
<u>TTK-005321</u>	GRENADA	Somprasert Kitiwiriyaikul	Slider_Contamination
<u>TTP-005313</u>	YELLOWJACKET	Jirawut Hongsakul	Drive_Low Drive Yield

2. SSO Newly Closed

SSO_NUM	PRODUCT	CREATOR	REASON
<u>PGS-004422</u>	--- ALL PRODUCTS ---	Ming Han Lee	Drive_Low Drive Yield
<u>PGS-004877</u>	EAGLE	Jason Yap	Unqualified Material
<u>PGS-005080</u>	EAGLE	Jason Yap	Unqualified Material
<u>TTK-005092</u>	GRENADA	Chanita Kerdrit	Slider_Contamination
<u>TTK-005093</u>	GRENADA	Chanita Kerdrit	Slider_Contamination
<u>TTK-005096</u>	GRENADA	Chanita Kerdrit	Hold for Eval
<u>TTK-005197</u>	HOLLIDAY	Pongladda Khraikratokke	Wafer-RTV for Rework/Reinspect/Investige

3. SSO Pending Closure

SSO_NUM	PRODUCT	TAT (Day)	CREATOR	REASON
<u>PGS-005173</u>	GRENADA	72	Narishah Mohamed Salleh	Wafer RP2 Corrosion
<u>PGS-005185</u>	GRENADA	72	Narishah Mohamed Salleh	Wafer - RP2 Corrosion
<u>PGS-005229</u>	YARRA	51	Narishah Mohamed Salleh	Wafer Front Shield Void
<u>PGS-005239</u>	COMPASS	48	Narishah Mohamed Salleh	Wafer Defects
<u>PGS-005265</u>	GRENADA	29	Narishah Mohamed Salleh	Wafer Defects
<u>PGS-004690</u>	AIRWALKER	267	Anand Raman	Slider_Contamination
<u>PGS-004981</u>	EAGLE	159	Anand Raman	Mix Different Wafer by Tab
<u>PGS-005058</u>	EAGLE	125	Anand Raman	Slider_Mode 2 Scratches
<u>PGS-005060</u>	EAGLE	125	Anand Raman	Slider_Mode 2 Scratches
<u>SST-004958</u>	EAGLE	168	Noel Mcelholm	Unqualified material for dri
<u>SST-005016</u>	EAGLE	141	Noel Mcelholm	Unqualified material for dri
<u>TTP-005280</u>	EAGLE	19	Jirawut Hongsakul	Drive_Low Drive Yield
<u>RHO-005015</u>	--- ALL PRODUCTS ---	145	Sara L Anderson	High ATI Failure at Drive
<u>RHO-005140</u>	VALKYRIE	89	Sara L An derson	Control Build
<u>PGS-005075</u>	--- ALL PRODUCTS ---	112	Su Yang Ooi	Slider_DEB Blend to ABS
<u>PGS-005144</u>	--- ALL PRODUCTS ---	86	Lai Aun Tay	Slider_DEB Blend to ABS
<u>PGS-005164</u>	--- ALL PRODUCTS ---	79	Lai Aun Tay	Slider_DEB Blend to ABS

<u>TTK-005104</u>	GRENADA	98	Somprasert Kitiwiriyaikul	Slider_ Contamination
<u>TTK-005112</u>	GRENADA	97	Somprasert Kitiwiriyaikul	Slider_ Contamination
<u>TTK-005105</u>	MEGALODON	97	Wisit Techalertavornkul	Hold for Special Build
<u>TTK-005196</u>	MEGALODON	69	Wisit Techalertavornkul	Slider_ Contamination
<u>TTP-005292</u>	M8RHO	14	Pranee Rudeekriengkai	System Test ing
<u>SST-005152</u>	HOLLIDAY	83	Kevin Kennedy	Wafer_ Void Defect from W
<u>TTK-005138</u>	GRENADA	90	Chanita Kerdrit	Wafer - RP2 Corrosion
<u>TTP-004810</u>	GRENADA	229	Savica Limpasuvanna	Bar Tilt Problem
<u>TTP-004896</u>	GRENADA	198	Savica Limpasuvanna	Control Build
<u>TTP-004897</u>	GRENADA	198	Savica Limpasuvanna	Control Build
<u>TTP-004898</u>	GRENADA	198	Savica Limpasuvanna	Control Build
<u>TTP-004911</u>	GRENADA	195	Savica Limpasuvanna	Control Build
<u>TTK-005149</u>	GRENADA	85	Monthakarn Phirasaksophon	Hold for Eval
<u>TTK-005207</u>	GRENADA	68	Monthakarn Phirasaksophon	Wafer_ Abnormal Writer Po

4. SSO Pending Approval

SSO_NUM	PRODUCT	TAT (Hour)	CREATOR	REASON
<u>TTK-005311</u>	YARRABP	13	Wisit Techalertavornkul	Slider_Process Qual Data Verification
<u>TTK-005320</u>	GRENADA	6	Wichan Goomputsa	Alumina Separation

FED_SEAG0067917

Metadata

Attach Counts	0	ORIGINAL
Custodian	Lane_Ron	ORIGINAL
Custodian Other	Lane_Ron	ORIGINAL
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DATESENT	10/24/2012	ORIGINAL
DOEXT	eml	ORIGINAL
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FED_ENDATTACH	FED_SEAG0067919	ORIGINAL
FileName	SSO System - Daily Summary Report.eml	ORIGINAL
FILESIZE	27135	ORIGINAL
FROM	SSO System <SockAi.Lim@seagate.com>	ORIGINAL
MD5 Hash	78B8F078717960E424616E064FF51722	ORIGINAL
Message_ID	<3F7110B72C784A69A4131A2EA3D419D7@pgswebprt>	ORIGINAL
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Relativity Image Count	3	ORIGINAL
Relativity Native Time Zone Offset	-8.00	ORIGINAL
TIMERECEIVED	8:45 AM	ORIGINAL
TIMESENT	8:45 AM	ORIGINAL
TO	Phantip.Asavathongkul@seagate.com;PhekKoon.Sho@seagate.com;Piangjai.Pongpaew@seagate.com;Pissamai.Suyana@seagate.com;PohChong.Tang@seagate.com;Pramanathan.Saminathan@seagate.com;Prasong.Plaikaew@seagate.com;Rangsan.Keedmor@seagate.com;Ratana.Prugsala@seagate.com;Ratchanop.Lertwichamongkol@Seagate.com;Rob.Hardeman@seagate.com;Robert.J.DeVries@seagate.com;Robert.J.LaBore@seagate.com;Robert.Netzer@seagate.com;Roland.S.Choong@seagate.com;Ronald.E.Lane@seagate.com;Roong.Sivaratana@seagate.com;Rungchan.Saele@seagate.com;Sakarai.Andee@seagate.com;Sanicha.Toemphan@seagate.com;Sarnjay.Manocha@seagate.com;Sara.L.Anderson@seagate.com;Sasina.Puyati@seagate.com;SawSim.Lim@seagate.com;Sayan.Pruchya@seagate.com;Serge.A.Seliber@seagate.com;ShawYean.Chan@seagate.com;SiewSim.Goh@seagate.com;SinChuan.Ho@seagate.com;Sirirat.Jasoongnoen@seagate.com;Sombat.Hodee@seagate.com;Somchai.Kameesak@seagate.com;Somnuk.Sorapatt@seagate.com;Sompong.Ninrat@seagate.com;Somporn.Vairungroj@seagate.com;Somprasert.Kitiwiriakul@seagate.com;Songyout.Jirachapitak@seagate.com;SooChun.Loh@seagate.com;Srisakol.Trirat@seagate.com;Stephen.H.Magill@seagate.com;Stephen.J.Miller@seagate.com;Steven.J.Schneider@seagate.com;Suangsuda.Saengarammanojit@seagate.com;SuanPoh.Lim@seagate.com;Subhash.Garg@seagate.com;Sunichanun.Jomkumsing@seagate.com;Supaluk.Pokakul@seagate.com;Supattra.Songkakul@seagate.com;Suphansiri.Ongsuriyanon@seagate.com;Supon.Jedjariyakul@seagate.com;Surachet.Sangda@seagate.com;Surawut.Onsakorn@seagate.com;Suriya.Thipsawatkul@seagate.com;Suwat.Kosangarlux@seagate.com;SwanChoo.Koay@seagate.com;SweeChow.Loo@seagate.com;TahHua.Chew@seagate.com;Hai.X.Xu@Seagate.com;Sati.Viensiri@seagate.com;TeeYu.Choo@seagate.com;TeikLeong.Hong@seagate.com;Terry.R.Houghtaling@seagate.com;Thanabalan.Karpagam@seagate.com;Thanit.Suksawang@Seagate.com;Thirayut.Boonmasai@seagate.com;Thomas.J.Dunlap@seagate.com;Timothy.J.Banke@seagate.com;TuckCheong.Teong@seagate.com;Varut.Vongsukharutai@seagate.com;Voravit.Nakwatananukool@seagate.com;WeeChuan.Loh@seagate.com;Weiping.Bao@seagate.com;Wenit.Seekwa@seagate.com;Wichai.Veerapadungphol@seagate.com;Wichai.Yindeetakul@seagate.com;Wichak.Phijsanit@seagate.com;Wichan.Goomputsa@seagate.com;Wichit.Pongkaew@seagate.com;William.B.Morton@seagate.com;William.H.Nunne@seagate.com;Wisit.Techalerttavornkul@seagate.com;Wutthichai.Tanpao@seagate.com;Xue.H.He@seagate.com;Yang.P.Pu@Seagate.com;YenSoon.Wong@seagate.com;YokeWoun.Lee@seagate.com;YokeYee.Yong@s@seagate.com;Yutachai.Wongwaiphinij@seagate.com;Zubaidah.AbdulGhani@seagate.com;YunHai.Z.Zhang@Seagate.com;Chakravarty.Barish@seagate.com;LiangSin.Siew@seagate.com;YehJuang.Phang@seagate.com;Run.Zhang@seagate.com;Yan.Liao@seagate.com;JianGuo.Xu@seagate.com;Tony.EG.Lim@seagate.com;xingjun.w.wang@seagate.com;Joanne.B.Ward@seagate.com;Ketruhai.Polachan@seagate.com	ORIGINAL

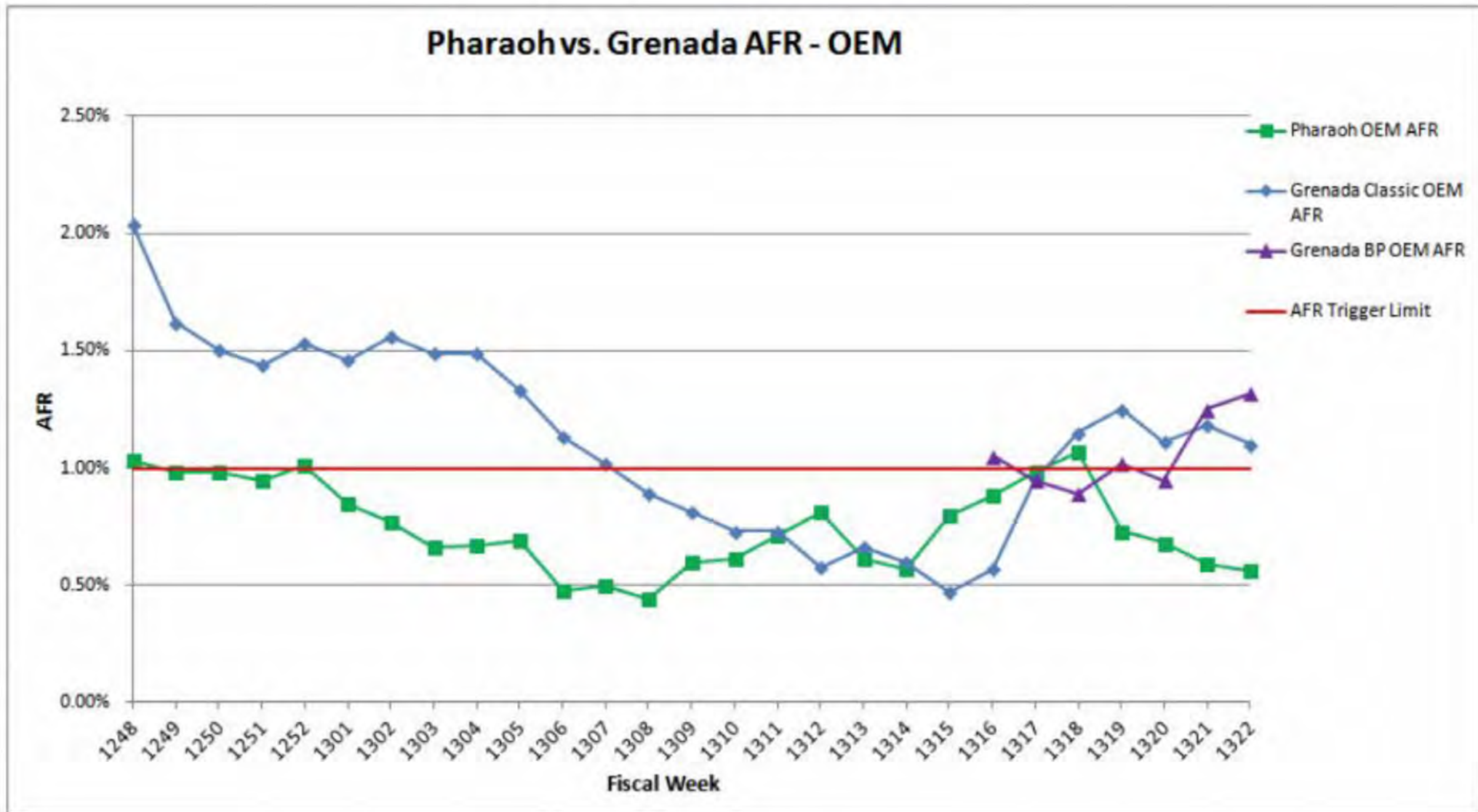
EXHIBIT 30

Grenada Quality Update

Korat and SZ Team
Nov 30, 2012



Grenada/Pharaoh AFR Comparison



Overview: Grenada Product Performances

Volume Q2'13 = 7.3M , Q3'13 = 9.4M
FY13 = 33.8M , FY14 = 48.4M

Quality

Grenada Classic	ODT 13-Wk MAV = 1034 Dppm ORT (Disty / OEM) = 138K / 219K MTBF
Grenada BP	ODT 13-Wk MAV = 1183 Dppm ORT (Disty / OEM) = 171K / 190K MTBF
Grenada BPPL	ODT 4-Wk MAV = 2325 K Dppm ORT (Retail) = 108K MTBF (Retail RDT test bed)
Grenada BPNLL	ODT 4-Wk MAV = 649 Dppm ORT (Std OEM) = 112K MTBF

Drive Prime Yield

Grenada Classic (QTD)

- 1 TB 90% vs 90% Budget
- 2 TB 81% vs 80% Budget
- 3 TB 76% vs 79% Budget. Mainly impacted from NHK tested with OEM spec

Grenada BP / NLL (QTD)

- 1 TB 91% vs 93% Budget. Mainly impacted from NHK tested with OEM spec
- 2 TB 83% vs 83% Budget
- 3 TB 82% vs 80% Budget

Grenada BPPL(QTD)

- 1 TB 76% vs 84% Budget
- 2 TB 72% vs 75% Budget
- 3 TB 65% vs 74% Budget

Grenada Classic ORT Summary

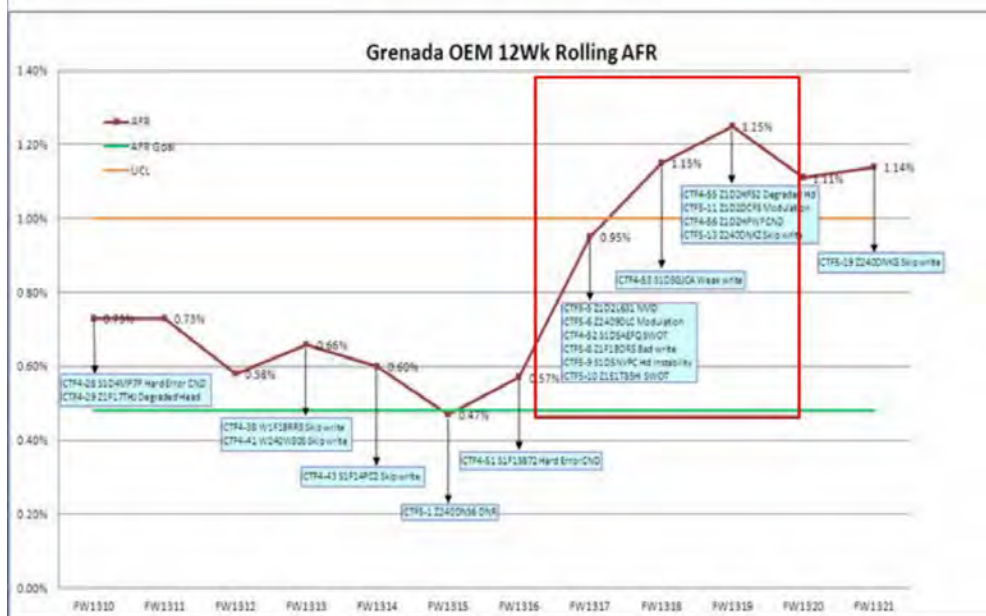
Grenada Classic OEM ORT Facts :

- Grenada classic OEM AFR increased from 0.6% (419K MTBF) to 1.25% WW19 (209K MTBF) higher than the trigger limit at 1% (250K MTBF).
- Failures are from DOM W12-W15. Main failures are contam and head related.
- Observed Korat rework showed high AFR at 2.1% (or 1.4% rework all sites) vs prime at 1.2% Korat (or 0.9% prime all sites).

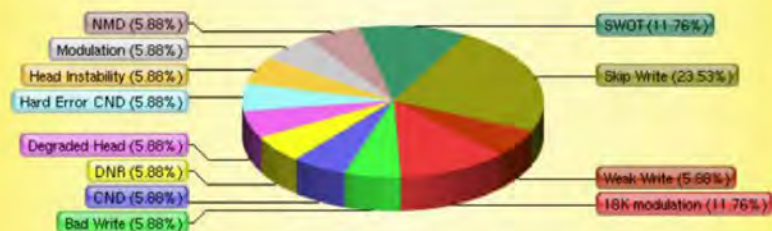
FA Findings:

- Major Fail modes fall under contamination, head related, SWOT and CND

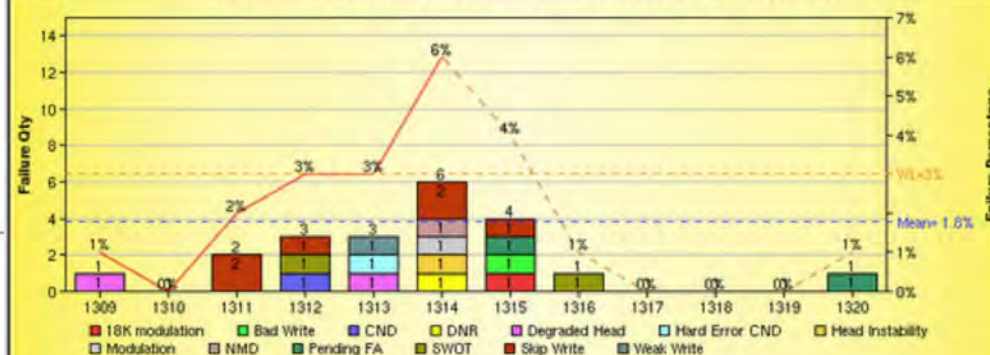
Grenada – OEM AFR Chart (AFR: 1.14%)



Grenada Failure Mode Pie Chart for past 5 weeks By DOM_WW(RDT)



Grenada 12 Weeks Failure Mode By DOM_WW (RDT)



Mean : Mean Failure Rate
WL : Warning Limit

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HIGHLY CONFIDENTIAL

FED_SEAG0067892

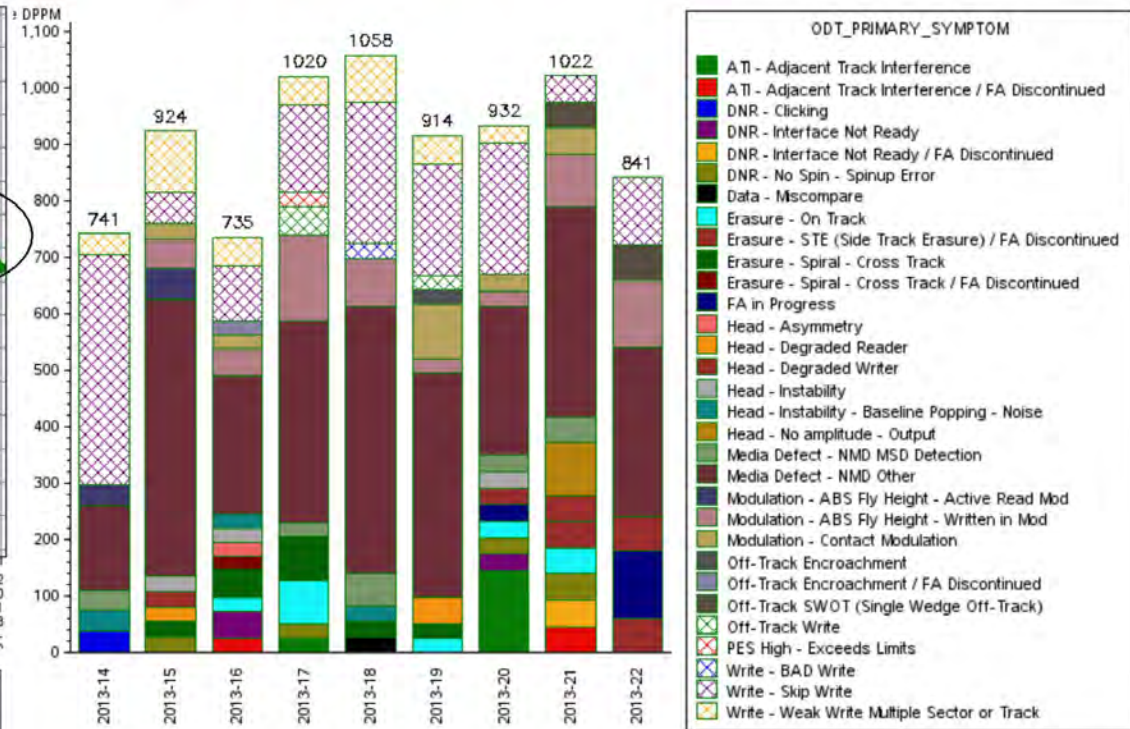
Grenada Classic OEM ORT Get Well Plan

Action	Who	When
Paper sort on hold drives and apply screening criteria for mass pro PCO - Servo Linearity and BURNISH CHECK - 3 to 5% yield impacted	Drive	W20 starts
Stop 4 CRX dates (Sep 17-18 , Oct 1 and Oct 3) for OEMs	Drive	W20 (Done)
2x cleaning for RTV HSA (10% ratio)	HSA	W20 (Done)
3-time ODT test maximum	Drive	W20 (Done)
Minimize Fujikura Hookup Loading (30% ratio)	HSA	W20 (Done)
Increase top cover torque by increasing preload from 35 to 60 PSI on screw no 1 and 4.	Drive	W21 (Done)
Talcum particle improvements - Slider Q tip cleaning - Operator handling improvement	All components	On going

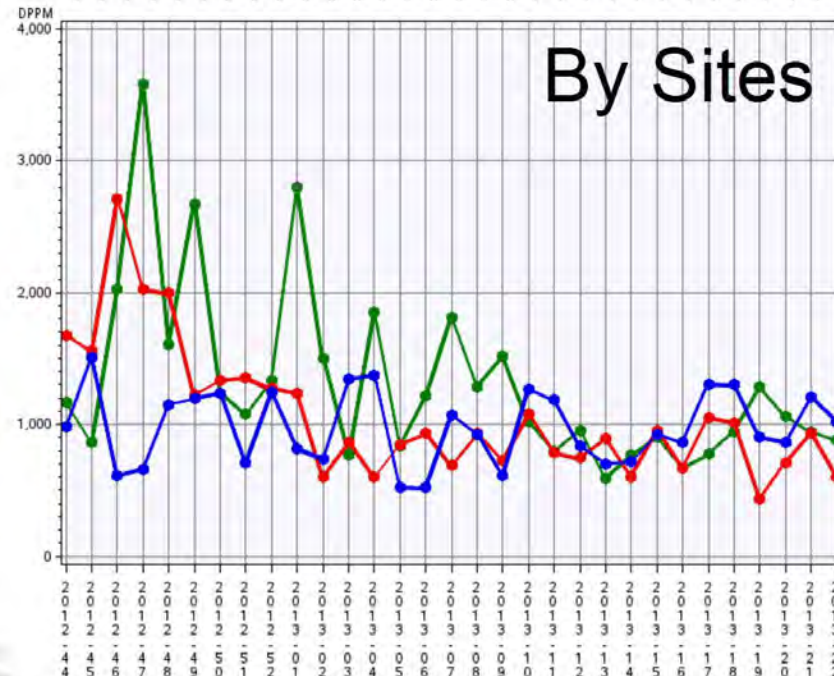
Drive DOM Week	Test Time So far	Testing Qty	Failure
DOM W16	864 Hrs	100	1x SWOT
DOM W17	696 Hrs	100	Zero
DOM W18	528 Hrs	100	Zero
DOM W19	360 Hrs	100	Zero
DOM W20	192 Hrs	100	1x NMD
DOM W12-15	Completed 1000	400	4% (16/400) failed

- ❖ New DOM loading from W16 showed low failure rate comparing to previous weeks.
 - 0.5% DOM W16-17 vs 2.3% pervious DOMs with TTF less than 576 hrs.
- ❖ Review to stop SSO for DOM W16 onwards by Nov 27.
- ❖ New drive samples with actions for validation starts in W23.

Grenada Classic LODT DPPM (OEM)



- Overall DPPM running at 1000 DPPM
- Observed ODT DPPM uptick since WW17
- Major Failure are NMD, FHM, SkipWrite
- Under investigation on Alphana Motor contribution to high DPPM



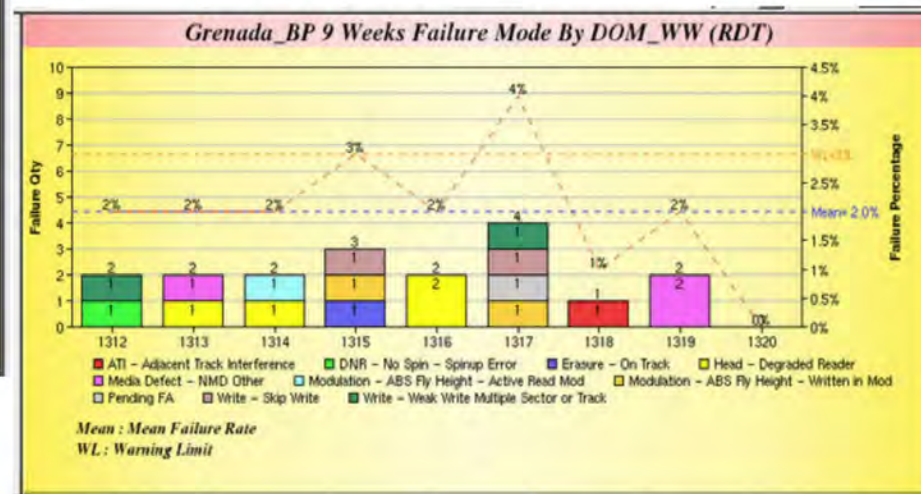
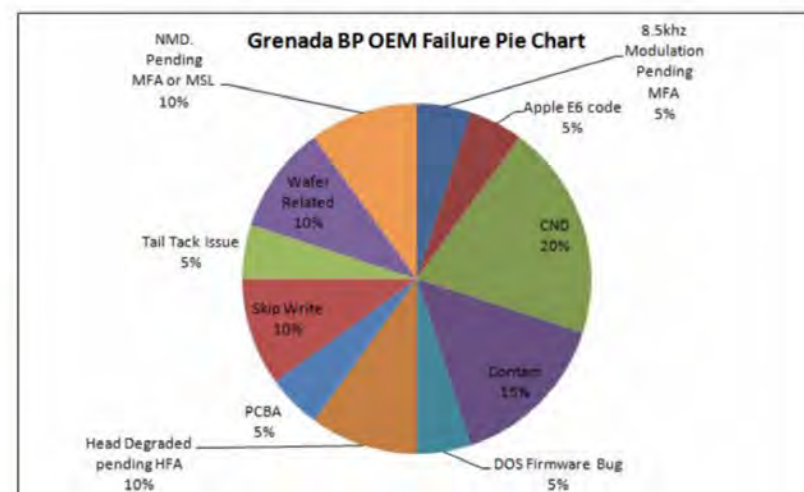
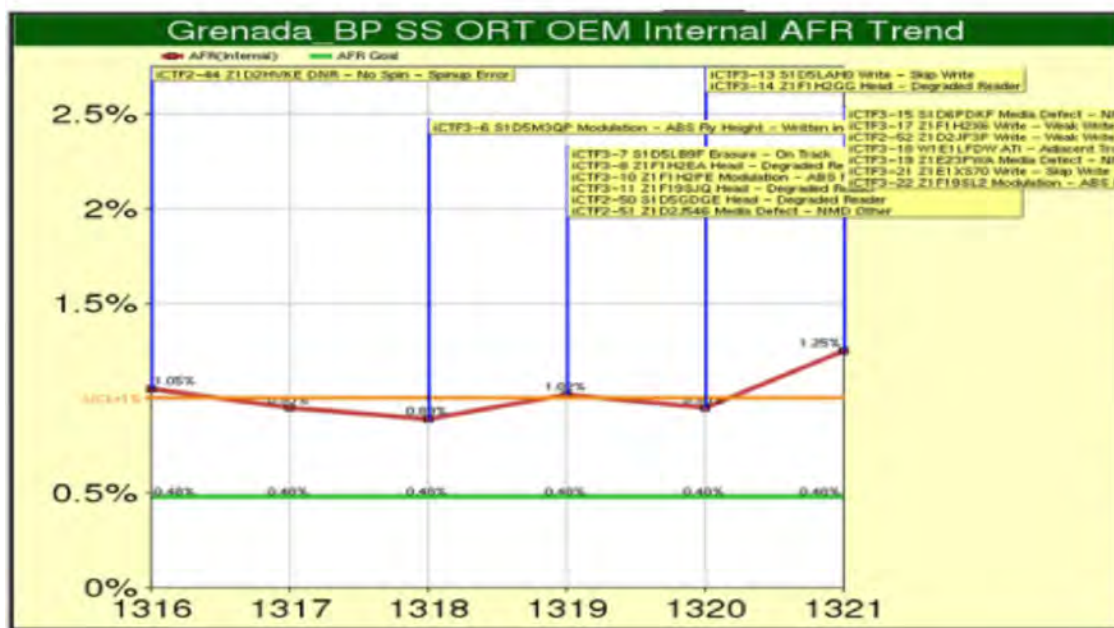
Grenada BP OEM ORT Updates

Grenada BP OEM ORT Facts :

- OEM RDT (for OEM approval) demonstrated 1.1% AFR (212K MTBF).
- There are 7 failures in W21 ; 2x NMD , 2x weak write , 1x skip write , 1x ATI and 1x modulation resulting to 1.25% AFR or 190K MTBF.

FA Findings:

- Major Fail modes fall under contamination, head related and CND



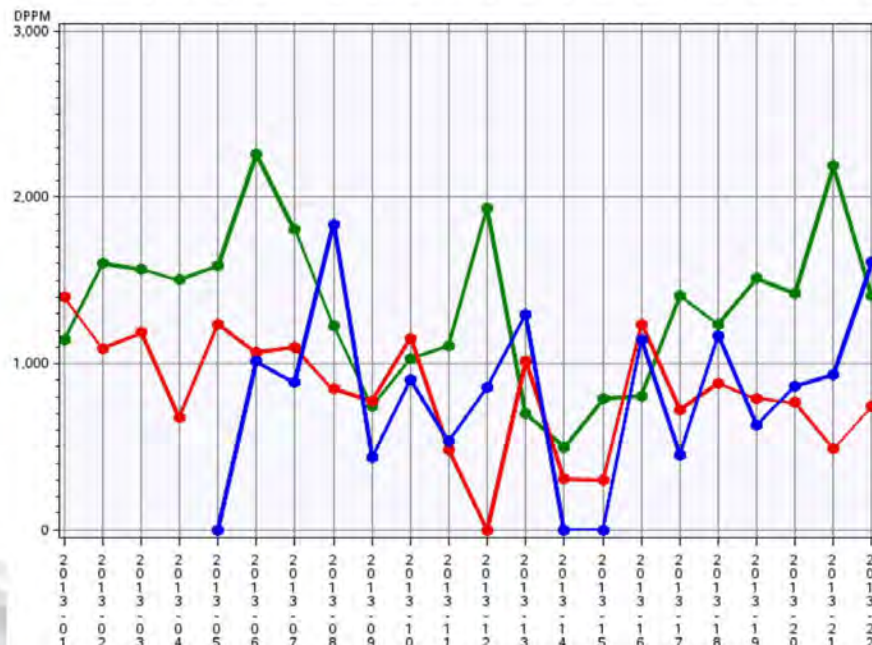
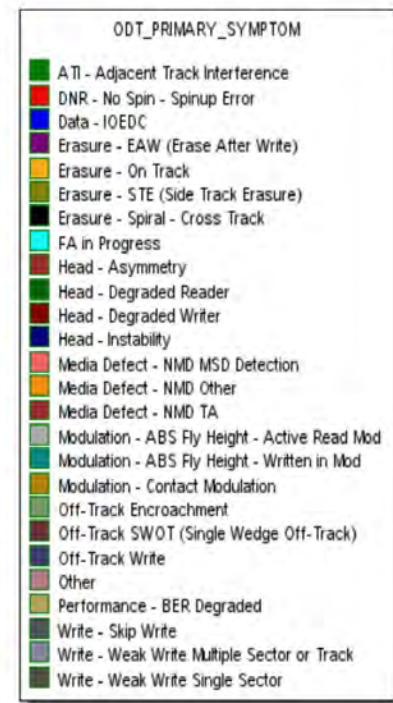
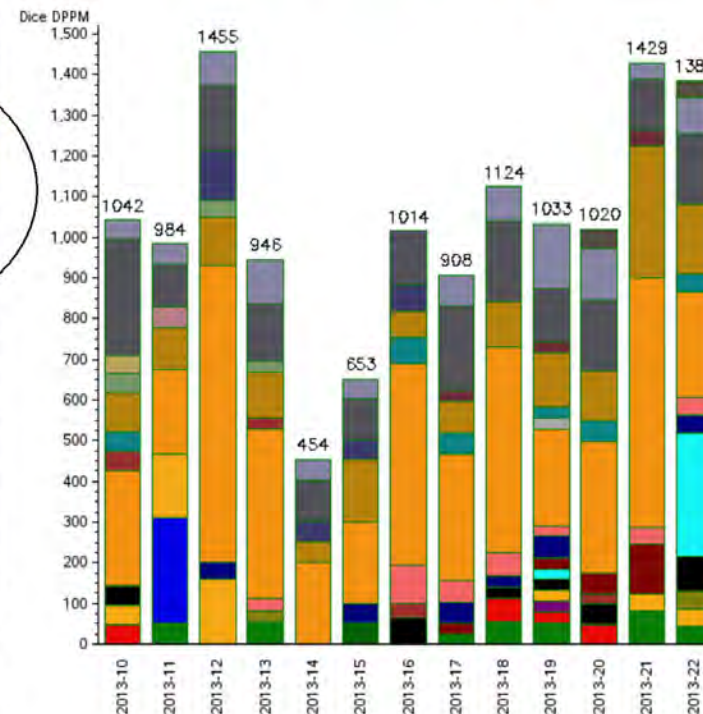
Grenada BP OEM ORT Get Well Plan

Action	Who	When
HSA New tail tack (new position and smaller dot size)	HSA	W20 (Done)
Paper sort on hold drives and apply screening criteria for mass pro PCO - HMS CAP , VBAR , BER and FLAW parameters - 10 to 15% yield impacted	Drive	W20 starts
Stop 4 CRX dates (Sep 17-18 , Oct 1 and Oct 3) for OEMs	Drive	W20 (Done)
2x cleaning for RTV HSA (10% ratio)	HSA	W20 (Done)
3-time ODT test maximum	Drive	W20 (Done)
Minimize Fujikura Hookup Loading (30% ratio)	HSA	W20 (Done)
Increase top cover torque by increasing preload from 35 to 60 PSI on screw no 1 and 4.	Drive	W21 (Done)
Talcum particle improvements - Slider Q tip cleaning - Operator handling improvement	All components	On going

Issue	Action	Who	When
Wafer Related	Short-term: Two Temp test/Knock-down test/Bar Bake	HAS	WW26
	Long-term: BP7.5 Fairlane Reader		Q3/4 FW13
Contam	Factory Cleanliness: - Slider Q tip cleaning - Operator handling improvement	All components	Ongoing
Tail Tack	HSA New tail tack (new position and smaller dot size)	HAS	WW20
Skip Write	MQM7.0 in PCO9.1C		WW22
DOS Firmware Bug	DOS3.0	Drive	TBD

- ❖ New drive samples with paper sort criteria are under reli demo. (100x RDT, 60x TVM)
 - So far , test time is at 168 hrs with no failure comparing to 0.1% (1/800) normal ORT test.
 - 1x failure from 60x TVM

Grenada BP LODT DPPM (Disti Mainly)



- Overall DPPM running at 1100 DPPM
- Observed ODT DPPM uptick since WW17
- Major Failure are NMD, FHM, SkipWrite
- Under investigation on Alphana Motor contribution to high DPPM

Grenada NLL

Latest sORT Performance:

- WW 21: AFR 7.97% MTBF 105.4K vs WW 20: AFR 6.58% MTBF 128.6K

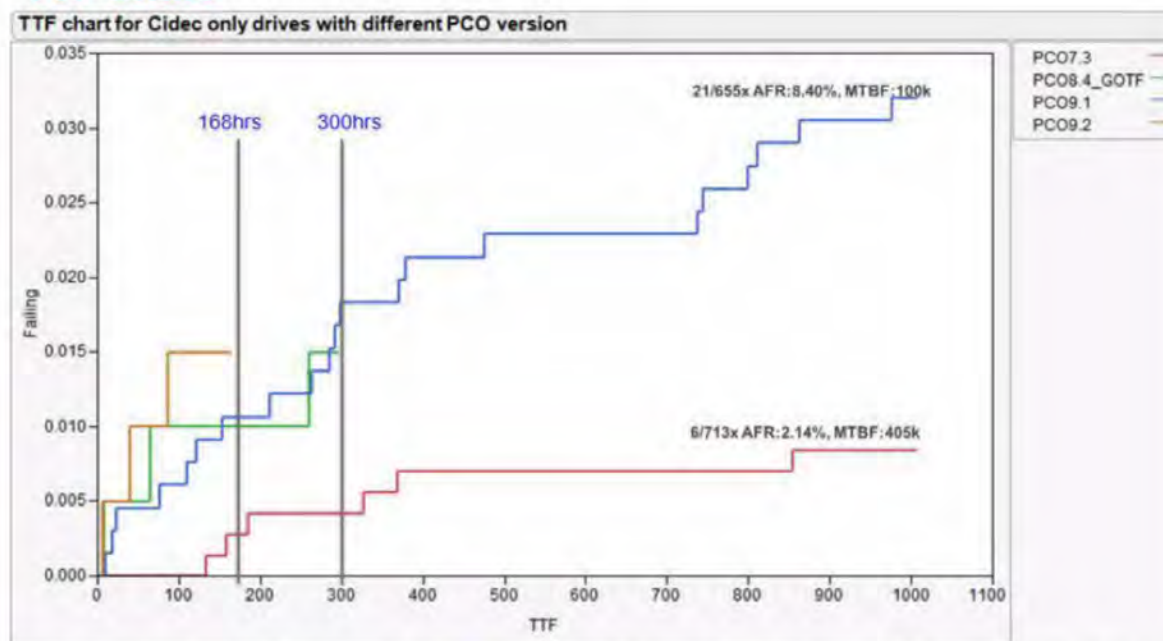
SSO Release Plan

GOTF Paper Sort + MQM + paper sort screen (degraded head)

Reach 296 Hrs: 3 Failures out of 200x Tested

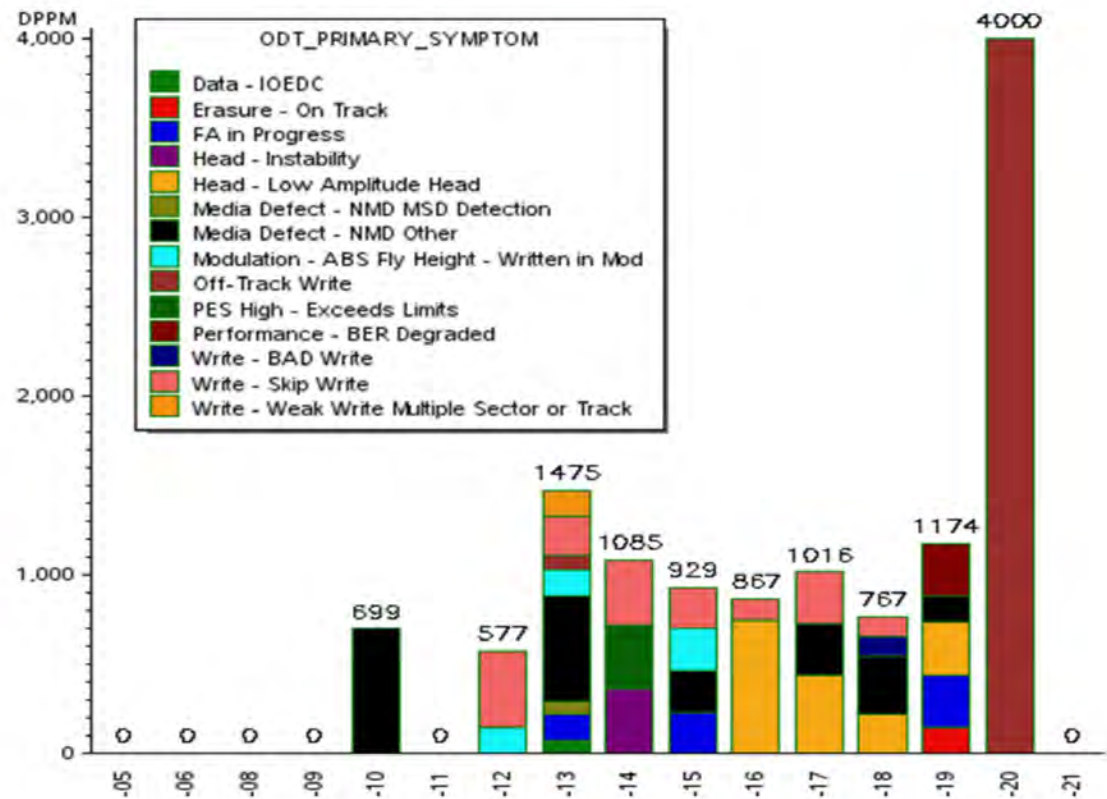
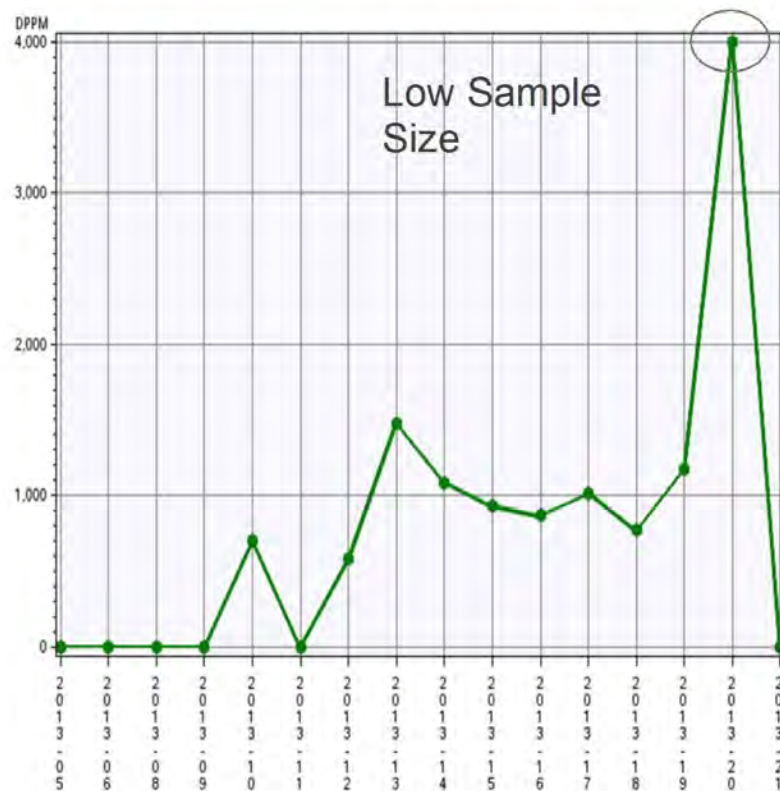
(1x Head degradation, 1x CND, 1x NMD) vs PCO 9.1: 7 Failures under 168 Hrs (7 out of 700x tested)

TTF chart



- > For PC09.1 Nidec only sORT test bed, total 21x failures. 7x failures with TTF < 168hrs, 12x failures with TTF < 300hrs.
- > For PC08.4+GOTF tighten spec test bed(drives failed EC10468 during DST short after 31hrs' testing(related to code flash, run clean up and re-start the test on Nov 19), test time so far: 296hrs) 3/200x 1xDegaded Head(SOF314237, Z1F1CXFH, TTF:7.7hrs); 1xHard Error CND(SOF315215, Z1F1CSD1, TTF: 64hrs); 1xNMD(SOF316811, Z1F1CRH1, TTF: 259hrs);
- > For PC09.2 test bed (test started on Nov23, test time so far: 164hrs) 3/200x 1xWeak Write(SOF315950, Z1F1FNEW, TTF: 6.4hrs); 1xBad Write(SOF315952, Z1F1FQNH, TTF: 39.9hrs); 1xNMD(SOF316438, Z1F1FQ3X, TTF: 86.2hrs)

Grenada NLL LODT DPPM (Only Korat)



- Overall DPPM running at 1000 DPPM
- Stop build since WW18 due to AFR Trigger
- Mainly Failure Pareto are Head Low Amp, NMD and RSS Writer

Grenada NLL Failure Pareto

Latest sORT Performance:

WW 21: AFR 7.97% MTBF 105.4K vs WW 20: AFR 6.58% MTBF 128.6K

4x New Failures: 1x NMD TTF 975.8 Hrs, 1x Skip Write TTF 743.9 Hrs, 1x FHM TTF 737.4 Hrs, and 1x Off Track Encroachment TTF 798 Hrs)

	Pareto	Percent	Total	Correction Actions	CA WW22	CA WW23	CA WW24	CA WW25	CA WW26	1D	2D	3D
Code related	Flash LED Autoseek firmware bug	7%	1	Z1F1F68C [CL502430, in AA8900] => Demo'd FE=40%, and Potential FE=100%								1
	EA Servo Code with PZT Oxidation fix.	7%	1	Z1F1F696 Code checkout in progress. Release WW22								1
	Suspect Bad Write, LSI preamp	7%	1	Z1D2S4AC, Drive in LCO for RC investigation - Update 11/28						1		
Head issues	Degraded Head	20%	3	Z1F1F6EN, Z1F1F6AE, Z1F1E6DM - (short-term) dual power delta ISI, estimated cut-in FW26 - (long-term) BP7.5 Fairlane reader => Q3/4 FW13								3
	Head - Instability	7%	1	Z1E1T8EP - (short-term) dual power delta ISI, estimated cut-in FW26 - (long-term) BP7.5 Fairlane reader => Q3/4 FW13							1	
TA's, particles, cleanliness issues	NMD Type-2 (PS-Zipper)	7%	1	Z1F1FT57 [MQM7 in PCO9.1C and Factory cleanliness actions]								1
	NMD Type-1 (PS-Zipper)	20%	3	Z1F1F68X, Z1E1K2NV, Z1F1F6DF [MQM7 in PCO9.1C and Factory cleanliness actions]							1	2
	Write - Skip Write	7%	1	Z1D2SMFD [MQM7 in PCO9.1C and Factory cleanliness actions]						1		
SQE working	Bad PCBA ISS5306, ST Dillon	7%	1	Z1F1F6DA, Part sent to Italy for further investigation - Update 11/30								1
	DSP pad thickness out of spec	7%	1	Z1F1F6A5, CA driven by Korat SQE								1
	Under investigation for possible modulation	7%	1	Z1F1FTW2, suspect contamination related								1
Total			15							2	2	11

FED_SEAG0067889**Metadata**

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TimeLastMod	3:44 AM	ORIGINAL
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EXHIBIT 31

From: Sai S Varanasi <sai.s.varanasi@seagate.com>
Sent: Saturday, March 17, 2012 3:00 AM
To: Michael R Crump
Subject: Re: Fwd: Grenada SHIP HOLD - Status: SHIP HOLD(--SSO # KOR-0193-00) -- Grenada ORT DOM WW1234 TVM Trigger

This is the remnants of the last month's ort trigger. We paper screened for oems but we have some escape rate.
 New PCO material and tightened upstream hga specs are flowing through that are already showing improvement.

Best Regards
 Sai
 US cell 3039139309
 China cell 18662271002

On Mar 17, 2012 3:35 PM, "Michael R Crump" <michael.r.crump@seagate.com> wrote:
 Have we made any changes to the test or has product degraded?

Mike

Begin forwarded message:

From: Thanit Suksawang <thanit.suksawang@seagate.com>
Date: March 17, 2012 12:09:10 AM GMT+08:00
To: Norachet Saetang <norachet.saetang@seagate.com>, Ignatius Vun <ignatius.vun@seagate.com>, KianFatt Chong <kianfatt.chong@seagate.com>
Cc: "Piangruetai.Sivaratana" <Piangruetai.Sivaratana@seagate.com>, Nuttaset Luetragul <nuttaset.luetragul@seagate.com>, Jariya Poonsawat <jariya.poonsawat@seagate.com>, MeiYu C Cui <meiyu.c.cui@seagate.com>, GuoPing Gui <guoping.gui@seagate.com>, "Jerry.CC.Seh" <Jerry.CC.Seh@seagate.com>, Orawan Wiwattanajit <orawan.wiwattanajit@seagate.com>, Duongamol Anakamane <Duongamol.Anakamane@seagate.com>, Sudaduang Kongthongnok <sudaduang.kongthongnok@seagate.com>, Naruepone Kaewkanjana <naruepone.kaewkanjana@seagate.com>, Thanorm Gunjeakpong <thanorm.gunjeakpong@seagate.com>, Orapin Janprim <orapin.janprim@seagate.com>, Suangsuda Saengarammanojit <suangsuda.saengarammanojit@seagate.com>, Niran Lersnimitthum <Niran.Lersnimitthum@seagate.com>, Chittiporn Pupaichitkul <chittiporn.pupaichitkul@seagate.com>, Wibulporn Nilnam <wibulporn.nilnam@seagate.com>, Brijesh KU Singh <brijesh.ku.singh@seagate.com>, Sai S Varanasi <sai.s.varanasi@seagate.com>, Hari H Narayan <hari.h.narayan@seagate.com>, Tao Bai <tao.b.bai@seagate.com>, Jimmy S Sin <jimmy.s.sin@seagate.com>, Pat Dewey <pat.dewey@seagate.com>, Brent VanDerVliet <Brent.VanDerVliet@seagate.com>, Timothy J Peterson <timothy.j.peterson@seagate.com>, Michael L Foye <michael.l.foye@seagate.com>, Sittipong Jitsiriboon <sittipong.jitsiriboon@seagate.com>, Michael R Crump <michael.r.crump@seagate.com>, Gary Kelsic <Gary.F.Kelsic@seagate.com>, Michael L Cook <michael.l.cook@seagate.com>, Kevin D Stenvall

<kevin.d.stenvall@seagate.com>, Krishnan Subramanian <Krishnan.Subramanian@seagate.com>, Phinyada Phuwapariyathorn <phinyada.phuwapariyathorn@seagate.com>, "wilson.z.zhang" <wilson.z.zhang@seagate.com>, YehJuang Phang <yehjuang.phang@seagate.com>

Subject: Re: Fw: Grenada SHIP HOLD - Status: SHIP HOLD(--SSO # KOR-0193-00) -- Grenada ORT DOM WW1234 TVM Trigger

Hi ,
Grenada DOM W34 TVM trigger SSO Updates. Details in the attached file.

Background :

Grenada TVM DOM W34 showed 7.1% (8/113) failed rate over the trigger limit at 3%. Korat site showed 13.9% (6/43 drives) while Wuxi and SuZhou failed at 4.3% and 0% , resp. The failures are 3x head related , 1x bad write , 2x timeout , 1x 330K modulation and 1x spin up timeout. The failures are mainly from OEM at 8.6% (7/81) so that Korat OEM drives are putting on hold.

Long term trend for TVM failed rate is running at 4.8% average since W24. Only one week W25 showed failed rate at 2.5% lower than the trigger limit at 3%.

Investigations / FA:

- 3x head related are from SLT_05 (bad plating tool) affected period and wafers.
- 1x bad write is from LSI preamp. FA is doing in SuZhou with reviewing the data with LCO. Check point W38.
- 2x timeout are due to 1x PCBA related and 1x suspected media defects. Under 2nd level FA. Check point W38.
- 1x 330K Modulation (Tip Tab mode related). Drive is in Wuxi for MFA. Check point W38.
- 1x spin up timeout showed CND. Under retest , check point W37.

Impacts (Korat Drive ONLY):

- Korat Drive : 97.4K (12.4K FGI and 85K Shipped).

Actions :

- Issue stop ship to put FG drives on hold / Mar 15 [Done]

- Paper sort drives with SLT_05 and new GOTF . Downgrade failed drives to Disty and SBS based on PCO17.5 criteria / ECD Mar 16. Rebuild drives to replace failures (1539x 9YN164-541 , 105x 9YN166-033 , 579x 9YW162-500) , ECD W38.
- Retest drives in WIP (2.2K) with old PCOs with PCO17.5 for all 3 sites / Mar 15 [Done]
- Crunch SLT_05 affected drives for all DOMs / WIPs and sites to determine risk. About 15-20% of OEM drives are with SLT_05 / Mar 16 [Done]
- Review for non-SLT_05 material for Dell , HP and Lenovo / Mar 20.
- Continue further FA , On going with check point in W38.
- Review TVM trigger limit / Mar 16 – pending.

Supply :

- No issue.

On Thu, Mar 15, 2012 at 5:56 PM, Thanit Suksawang <thanit.suksawang@seagate.com> wrote:

Hi ,
Grenada DOM W34 TVM trigger SSO Updates. Details in the attached file.

Background :

Grenada TVM DOM W34 showed 6.2% (7/113) failed rate over the trigger limit at 3%. Korat site showed 11.6% (5/43 drives) while Wuxi and SuZhou failed at 4.3% and 0% , resp. The failures are 2x head related , 1x bad write , 2x timeout , 1x 330K modulation and 1x spin up timeout. The failures are mainly from OEM at 7.4% (6/81) so that Korat OEM drives are putting on hold.

Long term trend for TVM failed rate is running at 4.8% average since W24. Only one week W25 showed failed rate at 2.5% lower than the trigger limit at 3%.

Investigations / FA:

- 2x head related are from SLT_05 (bad plating tool) affected period and wafers.
- 1x bad write is from LSI preamp. FA is doing in SuZhou with reviewing the data with LCO. Check point W38.

- 2x timeout are due to 1x PCBA related and 1x suspected media defects. Under 2nd level FA. Check point W38.
- 1x 330K Modulation (Tip Tab mode related). Drive is in Wuxi for MFA. Check point W38.
- 1x spin up timeout showed CND. Under retest , check point W37.

Impacts (Korat Drive ONLY):

- Korat Drive : 97.4K (12.4K FGI and 85K Shipped).

Actions :

- Issue stop ship to put FG drives on hold / Mar 15
- Paper sort drives with SLT_05 and new GOTF . Downgrade failed drives to Disty and SBS based on PCO17.5 criteria / ECD Mar 16. Rebuild drives to replace failures (1539x 9YN164-541 , 105x 9YN166-033 , 579x 9YW162-500) , ECD W38.
- Retest drives in WIP (2.2K) with old PCOs with PCO17.5 for all 3 sites / Mar 15
- Crunch SLT_05 affected drives for all DOMs / WIPs and sites to determine risk / ECD Mar 16.
- Continue further FA , On going with check point in W38.
- Review TVM trigger limit / Mar 16.

Supply :

- Under review.

----- Forwarded message -----

From: <Brijesh.KU.Singh@seagate.com>

Date: Thu, Mar 15, 2012 at 5:43 PM

Subject: Fw: Grenada SHIP HOLD - Status: SHIP HOLD(--SSO # KOR-0193-00) -- Grenada ORT DOM WW1234 TVM Trigger

To: Asia_Shiphold@seagate.com

----- Forwarded by Brijesh KU Singh/Seagate on 03/15/2012 05:42 PM -----

<68157529.gif> **Ship Hold Order For Grenada**

<doclink.gif><doclink.gif>

<68507947.gif> Double Click Here to Access the Live Document!.

Title:	Grenada ORT DOM WW1234 TVM Trigger		
ShipHold Site:	KOR-Thailand	<ecblank.gif>	Status: SHIP HOLD
Product Model #:	ST3000DM001, ST2000DM001, ST1000DM003		SH#: KO SH-00316-00 Ref SSO#: KOR-0193-00
Part Number:	9YNxxx-xxx , 9YWxxx-xxx		
Date Created:	03/15/2012	Market Segment: PSG	VIQ: <ecblank.gif>
Revision History			
Ver Date Author Description of Change 00 12-Mar-15 05:34 PM Sarun Nantavisuth/Seagate Initial Release			

General

<graycol.gif> **Ship Hold Approval**

Ship Hold has been Approved by:	Brijesh KU Singh	Date Approved: 03/15/2012
Approver Comments:	No Comment	

<graycol.gif> **Reason**

Grenada ww34 DOM drives, TVM test has tripped 3% trigger limit. (6/7) failure are OEM drives.
Failures are : 3x Head Related , 2x Time out , 1x bad write , 1x modulation .

Decision to quarantine Korat DOM 34 drives. Wuxi and SuZhou SSOdecision will be made on Mar 16,2012, pending team review.

<68227025.gif>

Affected quantity.

Korat :

WIP = under data crunch.

FGI = 12388

Shipped = 76406

Wuxi : Under data crunch.

Suzhou : Under data crunch.

<graycol.gif> **Clearing Action**

Responsibility for Clearing:**Thanit S, Suangsuda S, Jariya P, Nuttaset L, Sarun N, Hari N.****Clearing Action:**

- FIS crunch and quarantine affected vintage. Sarun N. 15 Mar 2012.
- Wuxi / SuZhou data crunching. Rongen / Ailan Under crunching. est Mar 16,2012
- Korat Re-process affected vintage with PCO 17.5 Jariya / Thanit WW1238.

Locations Affected**Locations Affected:****Site Affected****Location(s) Affected: FGI, WIP****Conditional Releases**

<ecblank.gif>

Form: SSO99 03/15/2012 05:34:09 PM

Grenada Seagate Confidential

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Regards,
Thanit

--

Regards,
Thanit

<SSO-KOR-0193-00-R1.pptx>

FED_SEAG0055041**Metadata**

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Custodian Other	Crump_Michael	ORIGINAL
DATERECEIVED	3/17/2012	ORIGINAL
DATESENT	3/17/2012	ORIGINAL
DOEXT	eml	ORIGINAL
DOCTYPE	Internet Message (MIME)	ORIGINAL
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FED_ENDATTACH	FED_SEAG0055046	ORIGINAL
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FILESIZE	49613	ORIGINAL
FROM	Sai S Varanasi <sai.s.varanasi@seagate.com>	ORIGINAL
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OrgFolder	Crump_Michael\Michael_Crump_michael.r.crump@seagate.com_4.mbox\Crump_Michael\	ORIGINAL
RecordType	E-MAIL	ORIGINAL
Relativity Native Time Zone Offset	-8.00	ORIGINAL
TIMERECEIVED	2:59 AM	ORIGINAL
TIMESENT	2:59 AM	ORIGINAL
TO	Michael R Crump <michael.r.crump@seagate.com>	ORIGINAL

EXHIBIT 32

Seagate Internal Confidential

5-year BiC service life Strategic Reliability Initiative

Rev-2
Sept 03 2012

This is a proposal. Gathering feedback from
various teams.



Service life vs MTBF vs Warranty

Service life

A product's service life is its expected lifetime, or the acceptable period of use in service. It is the time that any manufactured item can be expected to be 'serviceable'. Service life is a unique commitment made by the item's manufacturer.

MTBF

MTBF is manufacturer's estimate of a failure rate during mission fulfillment. It is predicting the probability of failure within the service life.

Warranty

Warranty is an assurance by manufacturer to customer that specific performance is true or will happen. Customer is permitted to rely on that assurance and seek some type of remedy if it is not true. There are no direct legal and financial ramification if predicted MTBF or service life does not come true, unless it is specified in warranty document.

Service life measures as seen by customer

Segment	Mission time	Service life	MTBF	total FR over service life	Warranty
XYZ missile system	1 minute	20 years	20 minutes	5.00%	X years
Tier-0 SSD	24hrs a day	5 years	2.0 million	2.20%	5 years
Mission Critical HDD	24hrs a day	5 years	2.0 million	2.20%	5 years
Nearline HDD	24hrs a day	5 years	1.4 million	3.12%	5 years
Nearline-Lite HDD	24hrs a day	5 years	1.0 million	4.36%	3 years
DVR HDD	24hrs a day	5 years	2.0 million	2.20%	3 years
NB & DT OEM HDD	8 hrs a day	5 years	0.5 million	2.40%	3 years
NB & DT Disty HDD	8 hrs a day	5 years	0.5 million	2.40%	2 years
SBS Backup HDD	2 hrs a day	5 years	0.1 million	3.70%	0.5 year (?)

1. Above are reliability-warranty goals as committed by warranty reserves for products shipping in FY13
2. Request for Seagate-internal MR, DR, design, supply chain and manufacturing processes to meet above five year service life goal.
3. Five year service life will not be part of customer specs/contracts.
 - Will be discussed in customer presentations as part of product goals.

Workload Rating Characterizations

Workload & Rating			Market Segment & Predicted AFR & MTBF @ 8760POH			
Workload	GB/day	TB/yr	3.5" Desktop	NLL	Nearline	Mission Critical
Light	< 250	< 90	0.34% AFR → 700k hrs @ 2400 POH, 3 yrs (or 1.24% AFR → 700k hrs @8760, 3 yrs	1.09% AFR → 800k hrs, 3yrs (?) 0.88% AFR → 1M hrs, 3yrs		
	< 500	< 180				
Heavy	< 1,500	<550	n/a		0.62% AFR → 1.4M hrs, 5yrs	0.44% AFR → 2.0M hrs, 5yrs
Extreme	< 4,000?	<1,460				

Why five year service life

Purpose:

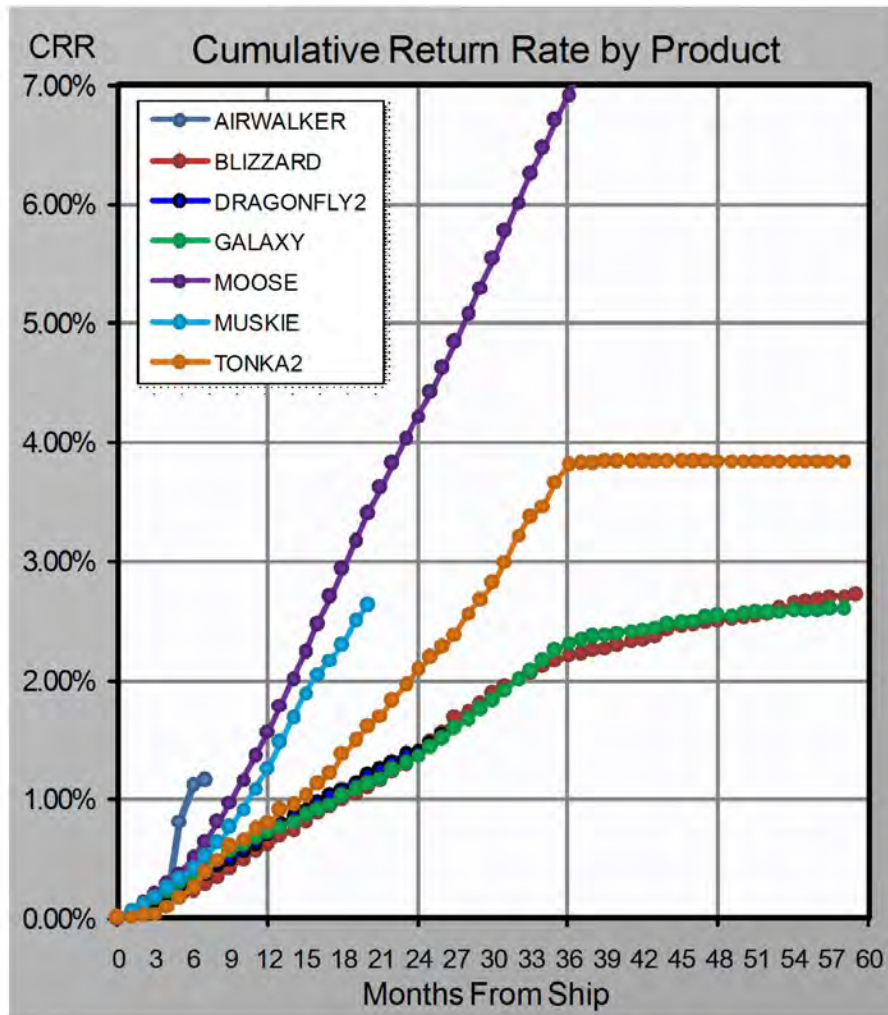
1. Meet customer expectations of total failure rate over five years.
 1. Mainly NL, DT, CE segments
2. A path to best in class reliability and meet our strategic initiative
3. Reduce excursions
4. Reduce warranty costs and compensation claims
5. Sustainable path for growth in market share

Intent:

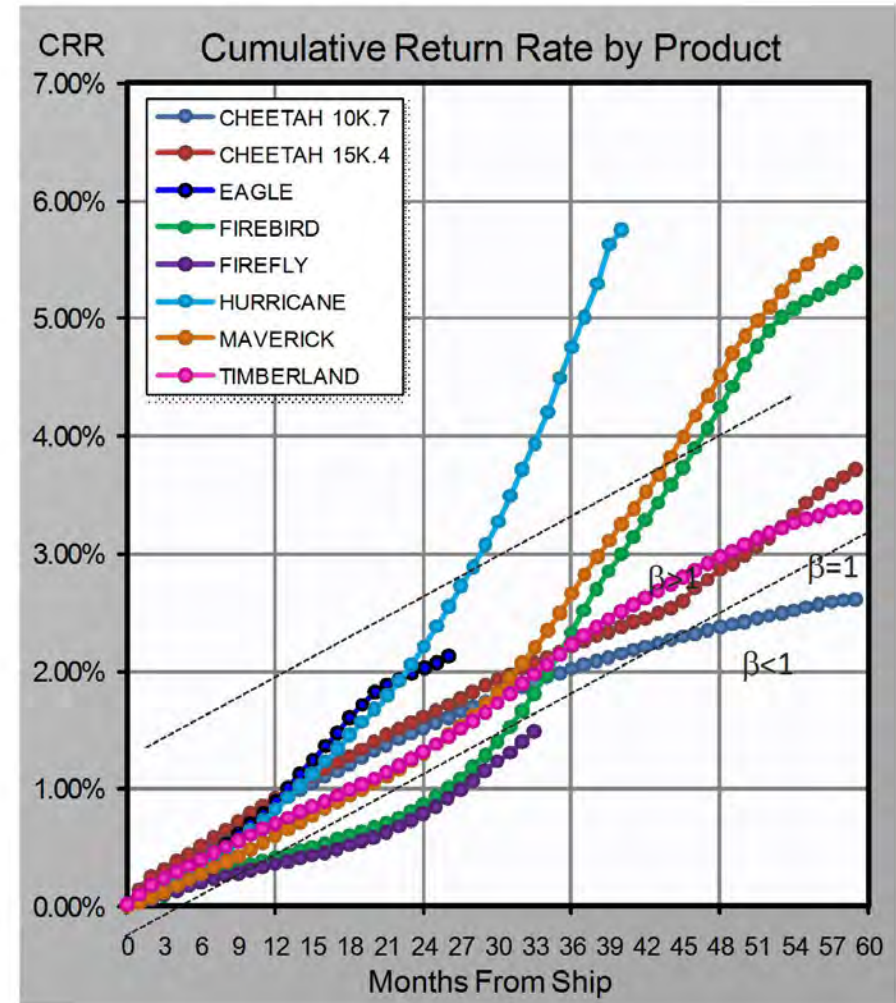
1. Enhance design process to explicitly target performance over five years and eliminate increase in late hour failures
2. Enhance reliability validation process for a 5 years.
3. Enhance supply chain and manufacturing quality and control processes.

ES field CRR charts

Nearline



Mission Critical



1. Most NL and MC drives show increasing failure rate with time in field.
2. NL product curves flatten after three years because of historical 3 year warranty terms

Need to update these charts

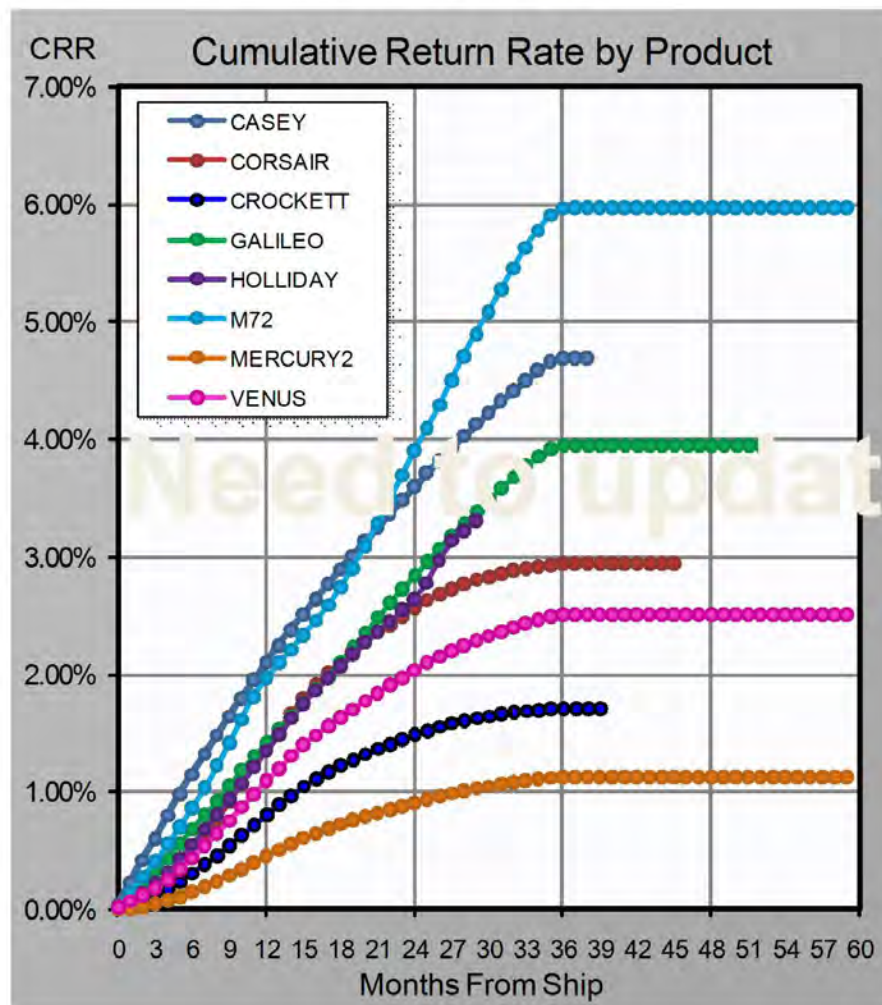
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Seagate 
Seagate Internal Confidential

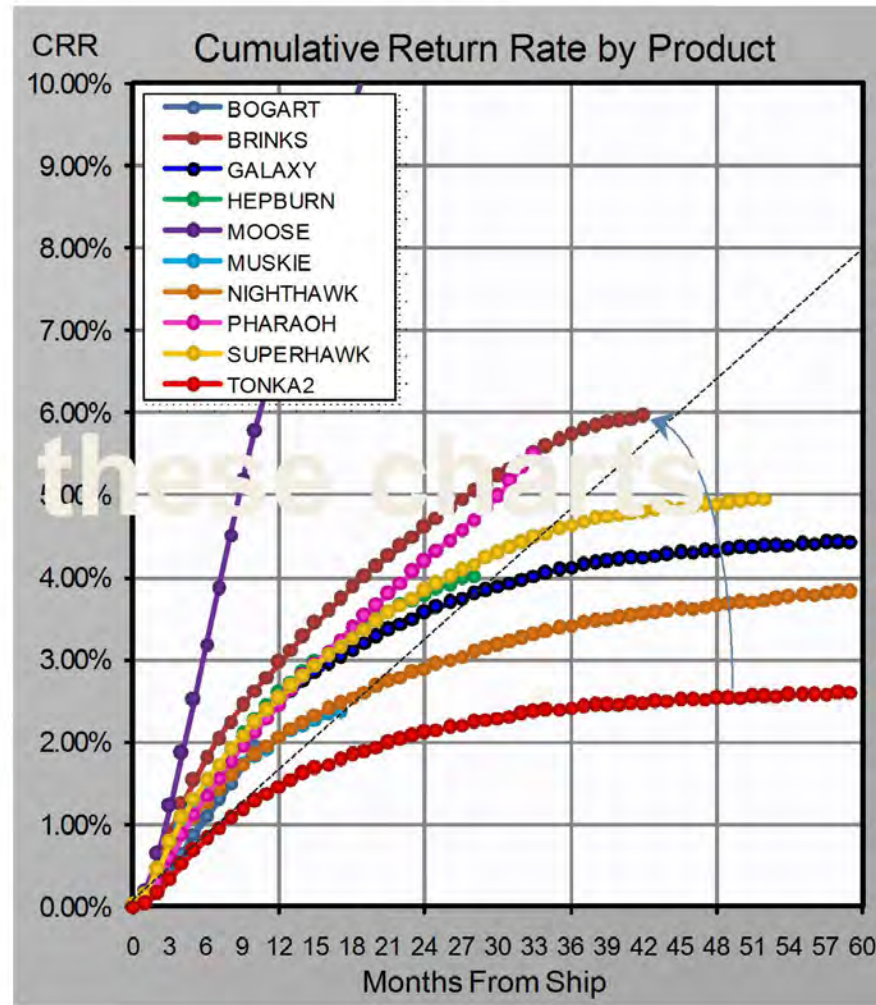
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Client field CRR charts

Notebook



Desktop



Client curve shows Beta < 1. However

1. Increasing OEM Warranty terms to 3 yr and disty to 2 years will increase beta. (more later hour failures will be returned to Seagate)
2. Tonka & Crockett showed entitlement to 2% CRR over two years

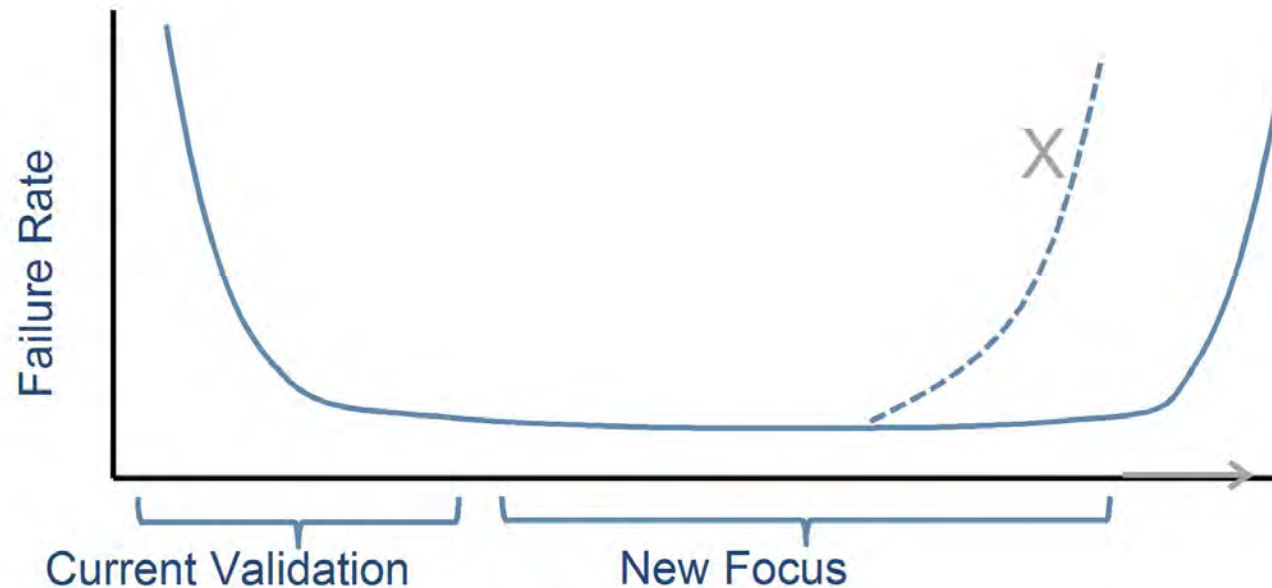
HIGHLY CONFIDENTIAL



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Reliability Challenge

-



Design, verify and build products to push the wear-out and degrading mode modes beyond the five year field usage conditions

ES Field and supply disruption issues

- **Hurricane:** TA, bearing hydrocarbon, stator wire contam, cone scratch
- **Timberland:** System Zone Dwell
- **Maverick/Firebird:** Breather filter, Pivot contam
- **Firefly:** Breather filter
- **Eagle:** TA, SV09 media, bearing hydrocarbon, stator wire contam, cone scratch
- **Compass:** Gasket Thixotrope
- **15k4:** Motor oil hydrolysis
- **Moose:** TA related degradation, Firmware
- **Muskie:** TA related degradation

Provide same chart for other segments

NB Field and supply disruption issues

- **Wyatt:** Wrong Sector Timing (Firmware), Weak Write (narrow writer), Acoustics Noise (head switch servo bug), MBA Hydro-carbon, Silane Outgas from TIM (Long Term Storage)
- **Holliday:** Weak Write (lazy writer), Acoustics Noise (head switch servo bug), Silane Outgas from TIM (Long Term Storage)
- **Desaru2D:** Weak Write (RHO Head, Lube pickup), Offset Write due to FW bug, Talc (Mg/Si/O) Contamination
- **Sapta15:** Head Degraded (Clearance related), cracked capacitors and PCBA to MBA tolerance issues
- **Julius:** Dell Slow Performance (FW bug, desktop only), SDOD (lift tab under ramp)

DT & DVR Field and supply disruption issues

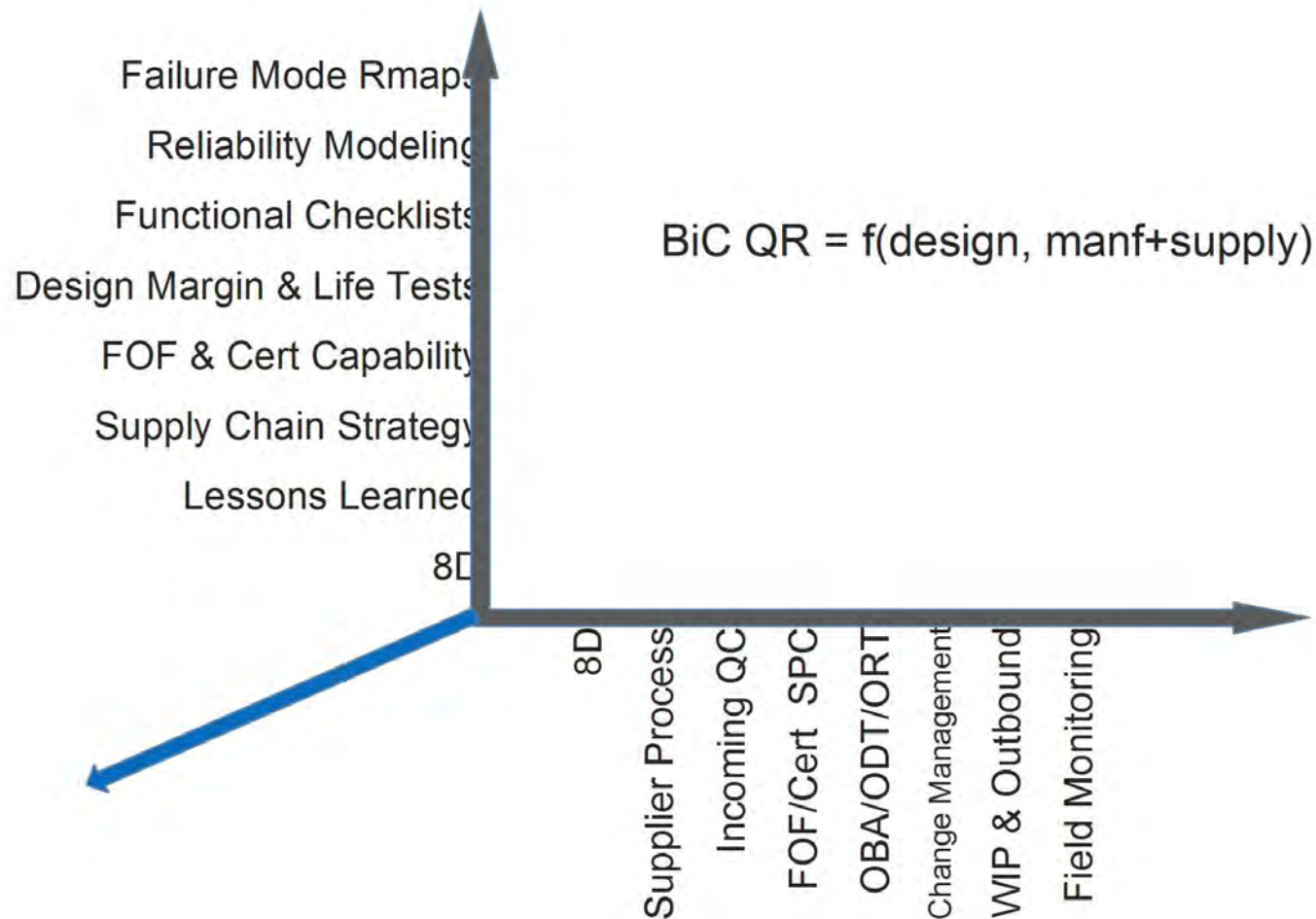
- **Grenada –**
 - NHK particulate contamination
 - Head instability
 - DSP tolerance to MBA
- **Hepburn**
 - Sticky crash stop
- **Bogart**
 - Media cache corruption
- **Pharaoh –**
 - Sticky crash stop
 - Command timeout at Iomega
 - Incorrect firmware (RQC @HP)
 - PFPE escalation (RQC @ Apple)

Critical Failure Modes (Reliability related)

	MC	NL	CE	DT	NB	SBS
HD contact degradation	1	1	5	5	3	
Organic contam	2	2	3	3	5	
Inorganic contam			4	4	6	
Shock induced			1	2	4	
Head instability			6	6	9	
Pivot & motor degradation	3	3			11	
Firmware induced			2	1	2	
Storage					8	
Weak Write					1	
Acoustics Noise					10	
SDOD					7	

Approach

1. Focus in development and supply chain processes



5Yr Service Life: Approach

Design: Eliminate the KPIV of critical modes

CEE: Test and predict to validate 5yr service life

SQE/Head/Media: Process qualifications and controls

Factory/QA: Process controls & change management

CTS: Active field monitoring and management

5Yr Service Life: Design Approach

Eliminate and/or define KPIVs for critical failure modes

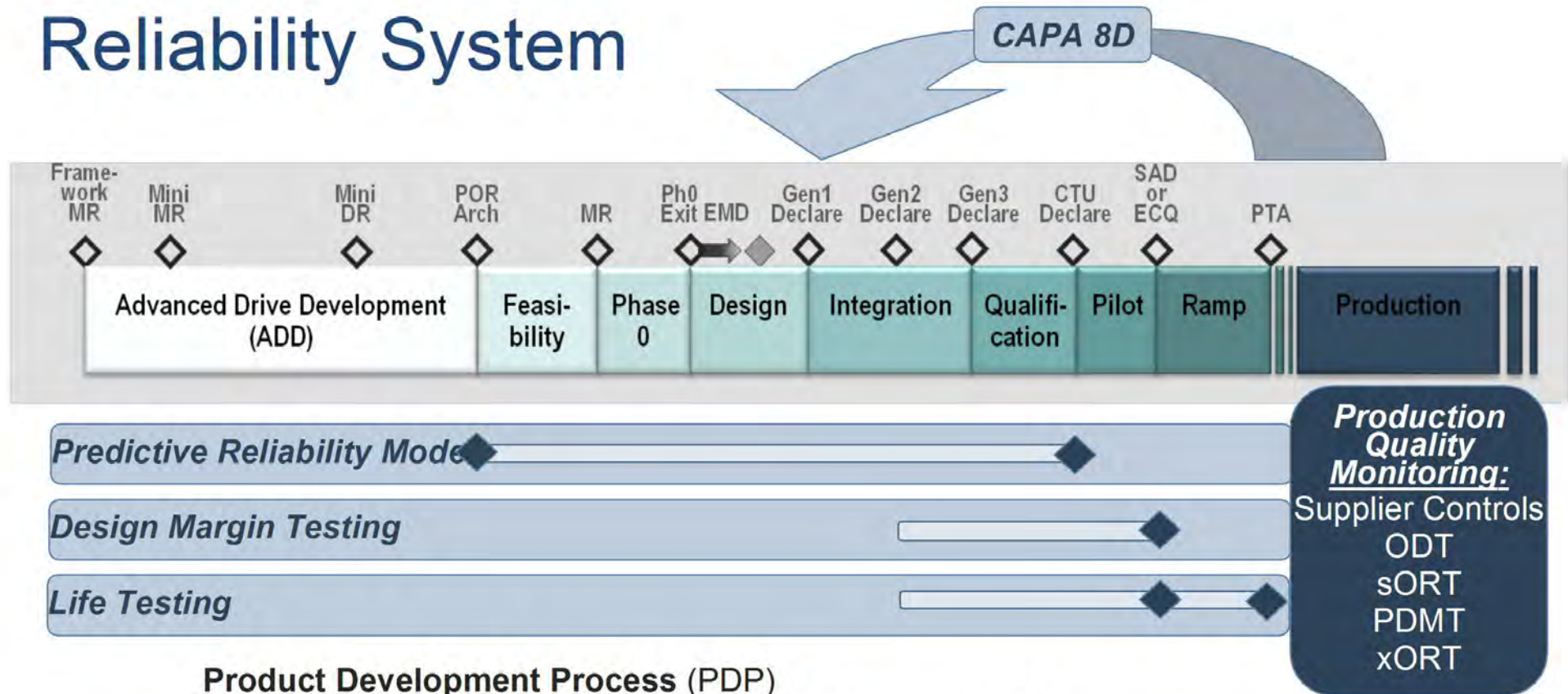
- Subsystem model
 - Physics of failure and model for all critical failure modes
- Eliminate KPIVs for existing modes
- FMEA on new technologies to drive actions across the company
- Functional checklists as phase gate process & criteria
- Tweak PDP to align to 5yr life validation to design margin
- Define upstream KPIV requirements to 5service

5Yr Service Life: Approach

CEE: Test to margin to validate 5yr service life

- Systems model for 5 years
- FM Improvement Roadmap (Reli model)
- Shared ownership for FMEA
- Design margin & life test validation
- Define/understand customer usage/stress

Reliability System



Product Development Process (PDP)

Predictive Reliability Model – Predict and validate 5 year AFR

Design Margin Testing – Test to limits of design for critical environmental factors

Life Testing – Validate service life of drive

PDP Enhancements – On-going improvements to PDP process to mature product quality.

Production Quality Monitoring

ODT (Ongoing Demonstration Test) – 24 integration test

sORT (Stress Ongoing Reliability Test) – 6 week accelerated stress test

PDMT (Periodic Design Margin Test) – Test unique stress conditions every 6 weeks

xORT (Extended ORT) – 26week accelerated stress test for 5 year service life

CAPA 8D – Continuous improvement to drive learning into next generation HDD

PDP Changes: CEE Recommendations

Strategic:

1. A raw mtbf metric starting Gen2 phase. Frank, Rich and KA have the action to make a proposal and compare to historical performance
2. Design margin testing, measurement and metrics.
3. Life test process and validation prior to SAD.
4. CEE functional check list. This would be similar to other functional checklist.
5. CCC (corp contam control) functional checklist.
6. Addition of subsystem modeling and design for life aspect into current functional checklist
7. ORT demo over 12 weeks prior to OEM SAD (aka OEM shipments).
8. SSD specific metrics -Dan Leprohon

Tactical:

1. NLL segment launch criteria
2. SBS DMT requirements
3. Officially requiring FA of RDT passers
4. Relook at dppm demo qty requirements
5. CET test process in reli lab as part of controller-firmware release process (this does not have to be in PDP document). Jim's team and our team are working on this process development.

Actions/Notes from Sept 05th call

Mike Troemel, Dan Kuhl, Sang Lee, HaeJung Lee and Sai in the call
Jeff, KF and Sai discussed prior to the call.

1. Should Client service life be 3 or 5 years ? What is the benefit of having 5 year service life for client products ? – Discussions at local sites and with PLM and CA
2. Make sure we close with PLM that the service life (if greater than warranty) is not part of customer legal contract – Sai to close. We will communicate the service life philosophy to customers to improve our reliability, but will not be part of legal contracts and specs.
3. Need to rollout the actual intent of system reliability modeling. Can we really model AFR impact of 2A of head carbon thickness change ? – Sai to take a shot at this
4. Double check on the failure modes in NL and ES segment that are causing beta >1 – Segar
5. Agreement on slide 12 and 13 on what the drive design and CEE teams would do different/better to meet the service life. Devil is in the details. Design and CEE teams will comeback with the next layer of details
6. Need to have high level actions/projects on what suppliers and factory would do different/better to meet the service life. - Sai to approach SQE, factory/QA,
7. For service life validation the proposal is to make sure that CTU declare and OEM SAD have three month gap. (to complete design margin, 12 week ORT and 6 month RDT) – DC leads to cross check the schedules
8. Next call in two weeks.
9. Continue to build on this package.
10. Site level discussions are underway on these specific topics.

FED_SEAG0055831**Metadata**

Attach Counts	0	ORIGINAL
AUTHOR	Niki Nakada	ORIGINAL
Custodian	Khurshudov_Andrei	ORIGINAL
Custodian Other	Khurshudov_Andrei	ORIGINAL
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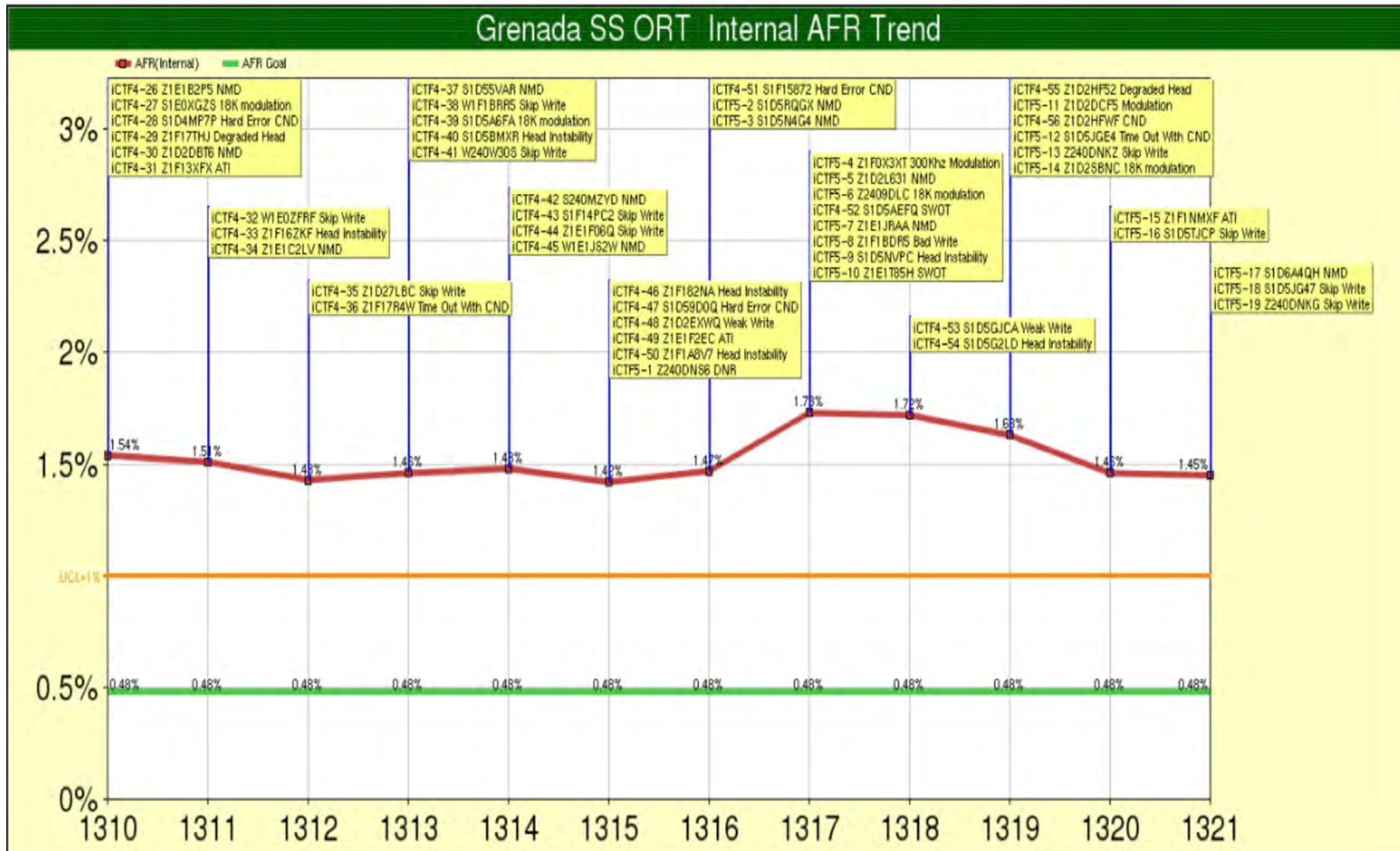
EXHIBIT 33

Grenada Internal/External Performance

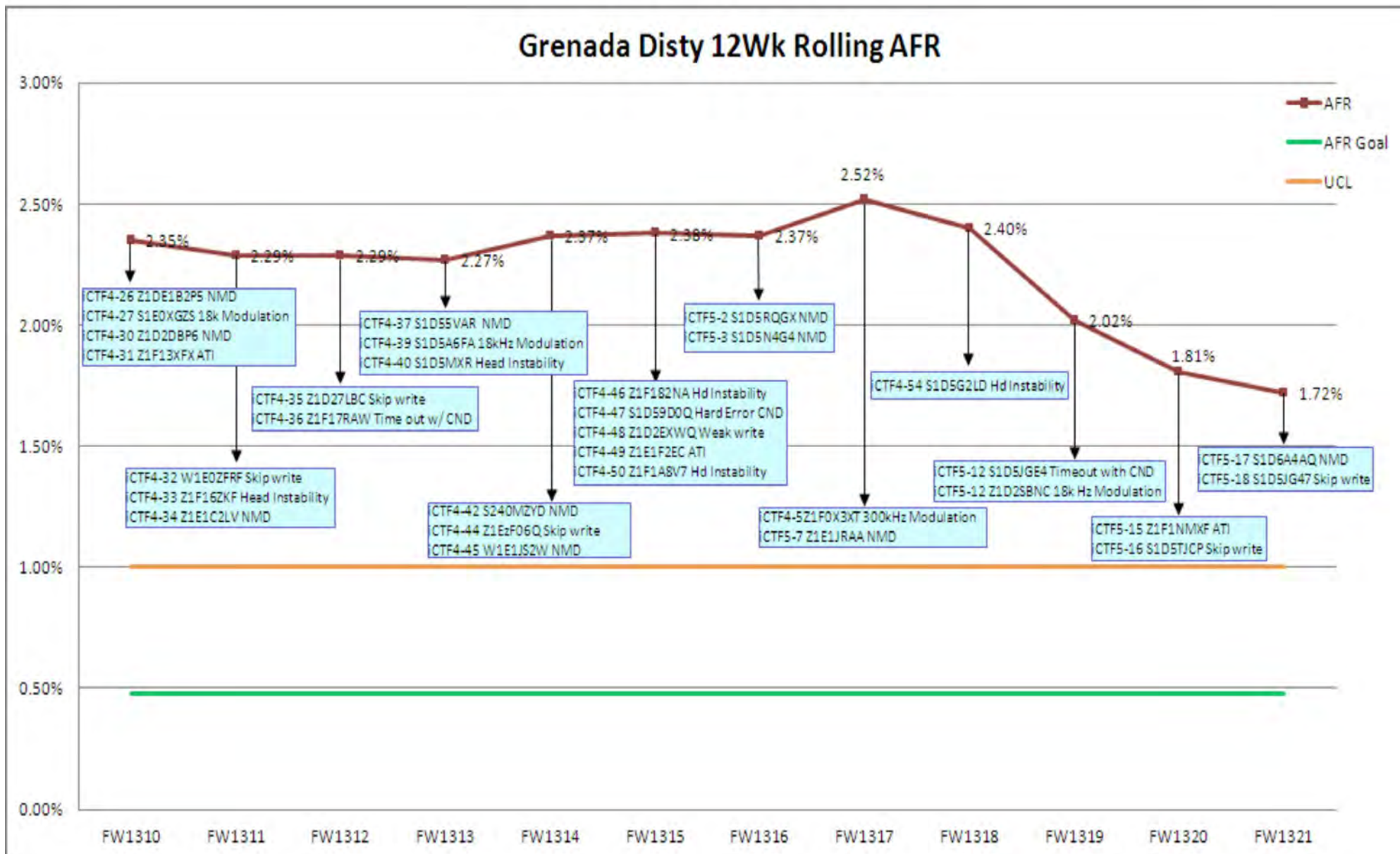


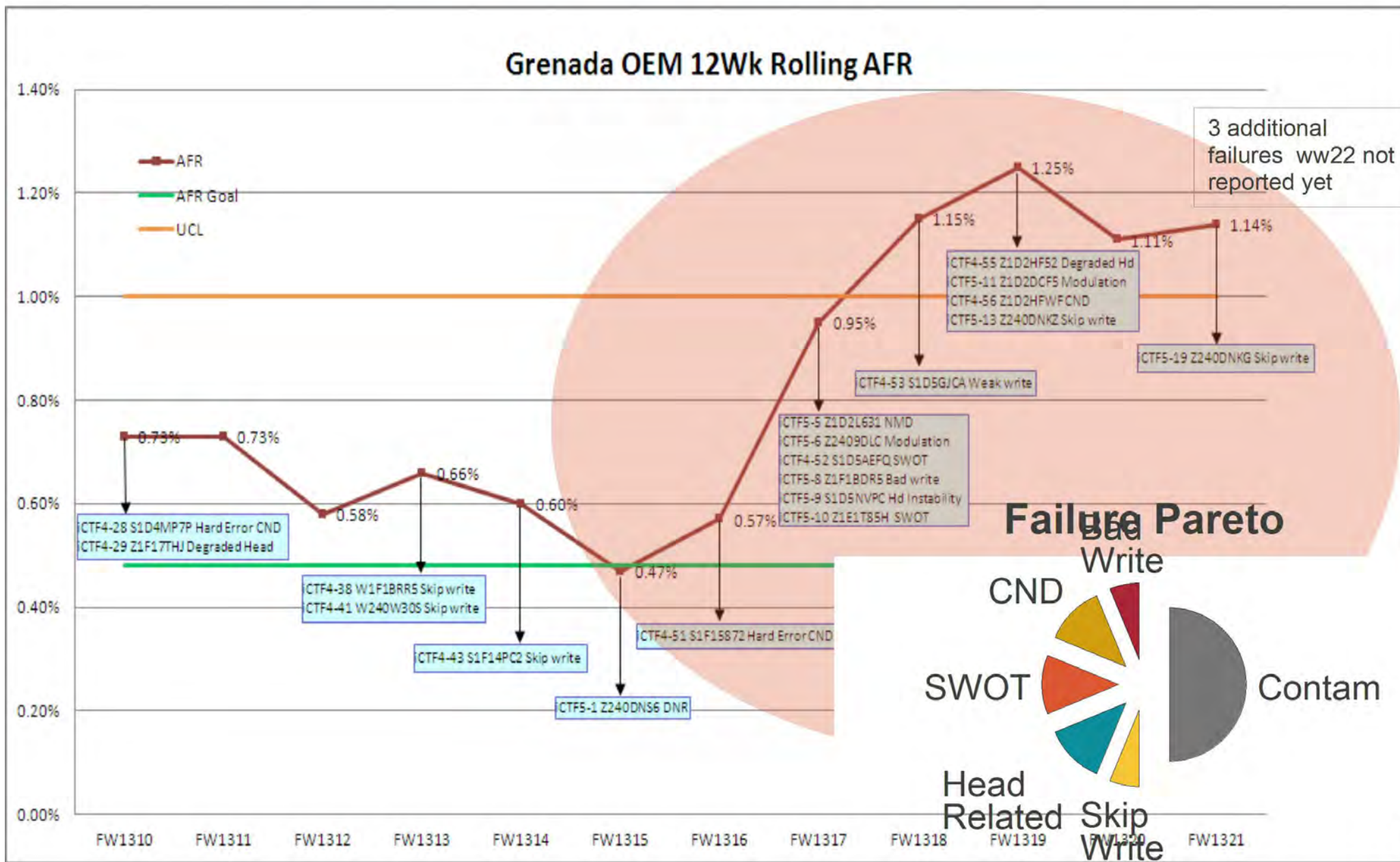
David Trane
11/29/12

Grenada ORT – OEM & Disty Combined (AFR: 1.45%)



Grenada – Disty AFR Chart (AFR: 1.72%)





Key Items

- 8x Contam related Failures – all but 1 are reworked
Talc is found in most of Contam related fails.
Suspect slider/HSA process.
Improvement plan included; slider, HSA, clean-room, RMO
- 1x Skip Write in FA
- 2x Head Related – 1x head instability, 1x Organic/ Cobalt smearing – further FA
- 2x SWOTs not repeating in Engr testing to date – focus on cover screw torque in DOE.
- 1x Bad Write can be closed with Write Back-off at Hot Fix in PCO11.17A (ww17)
- 2x CNDs

Clearing Action by Fail Serial Number

1st letter SN:
Z – Korat
S – Suzhou
W – Wuxi

	SN		Containment	Date	CA
8x (5x+3x new) Contamination Failures a) Implement max 3x ODT to OEMs b) Stop rework for OEM at Korat c) Big clean on affected lines in Korat (106,109,110,203) d) Stop HSA RTV in Korat e) Review incoming cleanliness f) Talc improvement (hand washing during gowning, CR paper control, glove clean on RW line, ctrl limit on Talc monitor, more...)					
	Z1D2DCF5 - (Modulation)	Rework	a) Max 3x ODT to OEM b) KORAT Stop rework to OEM c) KORAT Big Clean	11/16 11/14 11/14	Contam-related TBD
	Z240DNKZ - (skip write, Talc)	Rework	a) KORAT Stop rework to OEM b) KORAT Big Clean	11/14 11/14	Talc Improvement plan (slides 5,6) – ww22+
	Z1D2L631 - (NMD)	Rework	a) KORAT Stop rework to OEM b) KORAT Big Clean d) KORAT Stop RTV HSA	11/14 11/14 11/14	Contam-related TBD
	Z2409DLC - (T/O CND, 18kHz, Talc)	Prime	a) KORAT Big Clean b) Pending Incoming Cleanliness c) Potential paper screen indentified	11/16 11/20	Talc Improvement plan (slides 5,6) – ww22+
	Z1D2HF52 - (degraded hd reader, Talc)	Rework	a) KORAT Stop rework OEM	11/14	Talc Improvement plan (slides 5,6) – ww22+
	Z240DNKG – (suspect defect/contam – line 109)	Rework	a) KORAT Stop rework OEM b) KORAT Big Clean	11/14 11/14	Contam-related TBD
	Z240DNV1 - 18kHz mod, contam or HDI	Rework	a) KORAT Stop rework OEM b) KORAT Big Clean	11/14 11/14	Contam-related TBD
	W1E20QAZ – NMD scratch type 3	Rework	TBD	TBD	Contam-related TBD

Clearing Action by Fail Serial Number

SN		Containment	Date	CA
1x Skip Write Failures				
TBD				
S1D5JG47 – Skip write – FA in progress	Rework	Pending MFA	TBD	TBD
2x Head-related Failures				
Stop rework for OEM at Korat				
S1D5GJCA - (degraded hd writer, Org / Cobalt smearing)	Prime	None - pending final report	ECD 11/29	TBD
S1D5NVPC - (hd instability - AFM/SEM TTF 98 hrs 55C)	Prime	none - intrinsic	none	none
2x SWOT Failures				
a) Minimize Fujikura Hookup loading max 20% to non-critical OEM				
S1D5AEFQ - (TTF 625h, in beatup)	Rework	None – still not repeating	11/20	Expect to be CND ; Chamber induced.
Z1E1T85H - (TTF 19h, repeating SWOT)	Prime	a) Minimize Fujikura Hookup loading max 20% to non-critical OEM	11/16	Pending Servo-Mech Check point ww21
1x Bad Write Failure				
a) Reviewing ADG rules for OEM				
Z1F1BDR5 - (struggled in Process, 3x rework – PCO17.10B)	Rework	a) KORAT Stop rework to OEM b) Factory working on Combo Spec c) Checking write current back-off CA in place on BP	11/14 11/19	Current backoff @ hot FIX in PCO17.11A ww17
2x CND Failures				
a) Discount				
Z1D2HFWF - (lost comm, Gemini log full)		Discount due to tester issue, passed	11/15	Discount

Corrective Action	4M	Improve	Who	Implemented
> Integrate hand washing in gowning sequence	Man	Talc	Korat Slider	FW1321
			TK-HSA	Q2FY13 (Dec)
>Reduce CR paper usage 50% from FY11*	Material	Talc	TK-HSA	Q2FY13 (Dec)
			TK-Drive	Q2FY13 (Dec)
>Eliminate Desco Blue ESD Mat (by replace with talc free ESD mat)*	Material	Talc	Korat Slider	Q2FY13 (Dec) (PR/PO in process)
			TK-HSA	Q2FY13 (28 rolls on WW23)
			TK-Drive	Q2FY13 (6 rolls on WW23)
>Implement control limit for HSA LPC/Talcum monitoring	Method	Talc (detection)	TK-HSA	FW1321
>100% washing Bola tray cover Note: Currently clean by manual	Method	All	TK-HSA	FW1323
>2x Dip clean for 4HD/6HD RTV HSA Inventory	Method	All, Talc	TK-HSA	Short term
>100% ramp unload plate	Machine	Talc	RMO	Q2FY13 (Dec)
>MDW paddle daily swab clean	Machine	Talc	RMO	FW1321
>B/E conductive cassette	Material	Talc	RMO	Q2FY13

Corrective Action	4M	Improve	Who	Implemented
>100% glide head auto-clean	Machine	Talc	RMO	FW1318
>Implement new Ion Tip (Tal free) at Final Vision instead of Q-tip which consist of talcum. (Currently use Q-tip to clean ABS and Side Pad for judgment loos particle)	Material	Talc	Korat Slider	Q2FY13 (Dec)
> Critical area that direct exposure with Slider (Photo room, SFV). All open end will be encapsulated with shrink tube	Machine	Talc	Korat Slider	FW1321
>Change to use the new foil bag when paper enter cleanroom	Method	Talc	Korat Slider	Check point W21
>Refresh training operator do not put tweezers on blue mat	Method	Talc	Korat Slider	FW1321
>New Washing Detergent	Method	NiP, SST, Talc	MMI TH	FW1319
>Gloves cleaning every 2 hours at Teardown line	Method	All and Talc	Korat FOF	FW1322

1st letter SN:
Z – Korat
S – Suzhou
W – Wuxi

Failure Actions Timeline

						y	Containment Implemented								
						?	Corrective Action ECD								
						y	Corrective Action Implemented								
Issue	Pareto	# Fail	R/P	Actions	ww17	ww18	ww19	ww20	ww21	ww22	ww23	ww24	ww25	ww26	ww27
8x Contam	Rework-related	3	R	Containment	Max 3x ODT to OEM		y								
	>3x ODT runs	1	R		KORAT Stop rework to OEM		y								
	Cross-contamination	1	R		KORAT Stop RTV HSA		y								
	Cleanliness	4	R/P		KORAT Big Clean		y								
	Component	1	R		KORAT 2x RTV Dip clean				?						
	Talc (degrade reader)	2	R	Corrective Action	Talc CAs TBD					y					
1x Skip Write	Skip Write	1	R	Containment	none - pending final FA ww22					?					
				Corrective Action	none						?				
2x Head Related	Degraded Writer	1	P	Containment	none			?							
				Corrective Action	pending final head MFA					?					
	Instability	1	P	Containment	none										
				Corrective Action	none										
2x SWOT	SWOT repeating	1	P	Containment	Fujikura loading		y								
				Corrective Action	pending Servo-mech analysis						?				
	SWOT - pending repeat	1	R	Containment	none					?					
				Corrective Action	TBD - pending repeatability						?				
1x Other	Bad Write	1	R	Containment	review ADG rules				?						
				Corrective Action	PCO17.11A - write backoff FIX	y									
2x Discount	CND / NTF	2		Containment	both in retest		y								
				Corrective Action	Discount		y								
Leverage GrenadaBP Actions	Contam				MQM7 - review if feasible on CS						?				
	Skip Write				Tripad fix - review if feasible on CS						?				
	Degraded Reader				Dual power Delta ISI										y
	Hd Instability - SAF/AFM				Knock Down Test										y

Grenada External Quality Update

	Integration	Field	Excursions
Apple	N/A	N/A	
Acer	Over goal (Media Corrosion)	Under Goal	Media Corrosion; 27K drives returned
Asus	Over goal (30% Asus Induced)	Under Goal	
Dell	Under Goal	Under Goal	Media Corrosion; 25K drives returned
FTS	N/A	N/A	
Fujitsu	Over goal (Media Corrosion)	Monitoring Early Vintage DNR	Media Corrosion; 4.5K drives returned
HP	Under Goal	Under Goal	
Lenovo	Under Goal	Under Goal	
Samsung	N/A	N/A	

Crump's Field Charts

Seagate Confidential

12

HIGHLY CONFIDENTIAL

1

FED_SEAG0059629

FED_SEAG0059618**Metadata**

Attach Counts	0	ORIGINAL
AUTHOR	357636	ORIGINAL
Custodian	Crump_Michael	ORIGINAL
Custodian Other	Crump_Michael	ORIGINAL
DATECREATED	10/29/2012	ORIGINAL
DATELASTMOD	11/29/2012	ORIGINAL
DOEXT	pptx	ORIGINAL
DOCTYPE	MS PowerPoint 2007-2010 Presentation (O	ORIGINAL
FED_BEGATTACH	FED_SEAG0059617	ORIGINAL
FED_ENDATTACH	FED_SEAG0059629	ORIGINAL
FileName	Grenada Classic Internal & External Performance.pptx	ORIGINAL
FILESIZE	663265	ORIGINAL
MD5 Hash	EA8D28E124D04F355934E0CE913585D3	ORIGINAL
OrgFolder	041035\Crump_Michael\Michael_Crump_michael.r.crump@seagate.com_4.mbox\Cru mp_Michael\	ORIGINAL
Parent_ID	SG_CTRL0177519	ORIGINAL
RecordType	E-MAIL ATTACHMENT	ORIGINAL
Relativity Image Count	12	ORIGINAL
Relativity Native Time Zone Offset	-8.00	ORIGINAL
TIMECREATED	10:20 AM	ORIGINAL
TimeLastMod	3:45 PM	ORIGINAL
TITLE	Desktop RPT Exec Summary ww17	ORIGINAL

EXHIBIT 36

Subject: Re: Drives not being detected
From: Anik Rubalcava-Capretta <anik.rubalcava-capretta@seagate.com>
To: Mike S Carlow <mike.s.carlow@seagate.com>
Cc: John W Bornholdt <john.w.bornholdt@seagate.com>, Keith Myers <keith.r.myers@seagate.com>, Dave M Rollings <dave.m.rollings@seagate.com>

Mike,

Have you seen this issue with the Grenada drives not being detected? We showed the issue to Keith in Cupertino earlier this week.

This is a big issue at Equus and they are requesting this issue to be worked on during the holidays if it is not resolved beforehand. They have a 30% failure rate.

I'll have Equus ship you a few of the failing drives as well.

Thanks and Best Regards,

Anik

On Thu, Dec 15, 2011 at 10:56 AM, Mike S Carlow <mike.s.carlow@seagate.com> wrote:

John,

Grenada FW is now rolling to CC49 and should be available Monday. Once its available we will send a FW load package. At first glance at the FW changes they don't highlight and detection fixes.

We can try this new FW and go from there.

Mike

On Thu, Dec 15, 2011 at 11:15 AM, John W Bornholdt <john.w.bornholdt@seagate.com> wrote:

Hi Mike and Keith,

I understand that we're working on a firmware roll for the Grenada 3TB desktop drive. We got a large channel customer who has delivered several systems to Netflix with the 3TB drive, and they are failing at a very concerning rate. Netflix and Equus are both very anxious about what is happening, and it sounds like the firmware roll might address the issue. Is there anything we can do to expedite firmware delivery for Equus to validate the fix and keep these important customers in the fold?

Thanks,
John

John Bornholdt
Seagate Technology | Channel Sales - Central U.S.
Office: 952-923-1008 (*new office number*)
Mobile: 612-845-3695

----- Forwarded message -----

From: **John Dotson** <jdotson@equuscs.com>
Date: Thu, Dec 15, 2011 at 11:13 AM
Subject: RE: Drives not being detected
To: Anik Rubalcava-Capretta <anik.rubalcava-capretta@seagate.com>, "dave.m.rollings@seagate.com" <dave.m.rollings@seagate.com>
Cc: Will Wu <WWu@equuscs.com>, Tim Poor <TPoor@equuscs.com>, "john.w.bornholdt@seagate.com" <john.w.bornholdt@seagate.com>, Netty Ng <NNg@equuscs.com>, Eddie Ramirez <eramirez@equuscs.com>

Anik,

Did the firmware division give you an idea as to when the CC47 firmware will be available and released to you?

John

From: Anik Rubalcava-Capretta [<mailto:anik.rubalcava-capretta@seagate.com>]
Sent: Thursday, December 15, 2011 8:57 AM
To: John Dotson; dave.m.rollings@seagate.com
Cc: Will Wu; Tim Poor; john.w.bornholdt@seagate.com; Netty Ng; Eddie Ramirez
Subject: Re: Drives not being detected

Hi John,

I just left you a voicemail.

The new firmware revision is not available yet. I am waiting for firmware to send the firmware package.

As soon as I receive it, I will provide it to you as well.

Best Regards,

Anik

From: John Dotson [mailto:jdotson@equuscs.com]
Sent: Thursday, December 15, 2011 10:12 AM
To: John Dotson <jdotson@equuscs.com>; 'Anik Rubalcava-Capretta' <anik.rubalcava-capretta@seagate.com>; Dave M Rollings <dave.m.rollings@seagate.com>
Cc: Will Wu <WWu@equuscs.com>; Tim Poor <TPoor@equuscs.com>; 'John W Bornholdt' <john.w.bornholdt@seagate.com>; Netty Ng <NNg@equuscs.com>; Eddie Ramirez <eramirez@equuscs.com>
Subject: RE: Drives not being detected

Anik,

May I have an update this morning? The drives we sent to the customer are "failing" in large volumes, even though we pre-tested them before they shipped, and even though the customer pre-tested them before shipping to their end locations.

John

From: John Dotson
Sent: Wednesday, December 14, 2011 2:45 PM
To: 'Anik Rubalcava-Capretta'
Cc: Will Wu; Dave M Rollings; Tim Poor; John W Bornholdt; Netty Ng; Eddie Ramirez
Subject: RE: Drives not being detected

Anik,

Thanks for the update. The firmware CC47 must have just been released in the last couple of weeks, because you checked for me on 11/21 and there was not a firmware at that time.

Can you provide me the firmware and the release notes for CC47?

On the desktop platform I was testing the drive on, the boot time is pretty quick, and with those "failing" drives connected the motherboard would wait for about two minute and then time out. The other platform we are using takes from a cold boot about 20 seconds before it initializes the HBA firmware. If we disable the HBA firmware and let the system boot up, and then allow the driver to initialize the drives are still missing.

The OS the customer is using is freeBSD 9, but we are testing at the BIOS level, Windows XP and WinPE with the same results of not detecting at P.O.S.T.

John

From: Anik Rubalcava-Capretta [mailto:anik.rubalcava-capretta@seagate.com]

Sent: Wednesday, December 14, 2011 2:08 PM

To: John Dotson

Cc: Will Wu; Dave M Rollings; Tim Poor; John W Bornholdt; Netty Ng; Eddie Ramirez

Subject: Re: Drives not being detected

Hi John,

We retested the drives several times and were able to reproduce the issue.

It is an interesting issue because when we hook up our internal test tool to the drives, the drives power up consistently with no problems. If I remove the internal test tool the drives will fail to be recognized.

What OS are the drives used in? Are you aware how much time is allowed to spin-up?

The drives have an older revision of firmware, the latest revision is CC47. The next step will be to load the latest firmware and retest the drives.

After testing with the latest firmware revision, the next step will be to capture a bus trace of the failure. A bus trace will allow us to see what commands are being sent to the drive and how the drive is responding.

Best Regards,

Anik

On Wed, Dec 14, 2011 at 11:04 AM, John Dotson <jdotson@equuscs.com> wrote:

Anik,

Our customer is asking us for an update. Has your engineer been able to get any of the other QTY.4 drives to fail? Has he been able to analyze the problem with the drive that failed?

We have no shortage of drives that have cold boot problems, if you need more samples.

We did a quick power on test of the drives right after opening the packaging of 144 drives, and found 17 drives that were not detected upon a cold boot. After mounting the "good" drives into the systems, we are finding that some of those drives have cold boot problems.

Please advise if you need any more information or details from us to help in troubleshooting this issue.

John

From: John Dotson

Sent: Tuesday, December 13, 2011 2:32 PM

To: 'Anik Rubalcava-Capretta'

Cc: Will Wu; Dave M Rollings; Tim Poor; John W Bornholdt; Netty Ng; Eddie Ramirez

Subject: RE: Drives not being detected

Anik,

All the drives that we had sent were tested upon a second separate platform. It appeared that upon a cold boot (not having power applied to them for several minutes) the drives would not be detected, but then after a warm boot the drives were subsequently detected. If we powered the system down for a few minutes and then back on, the drive would exhibit the same behavior of not be detected again.

If a drive does not spin up or has a delayed spin up, would that information be stored in a log on the drive?

I have moved these drives to other platforms, and the "detection" problem follows the drives.

John

From: Anik Rubalcava-Capretta [mailto:anik.rubalcava-capretta@seagate.com]

Sent: Tuesday, December 13, 2011 2:27 PM

To: John Dotson

Cc: Will Wu; Dave M Rollings; Tim Poor; John W Bornholdt; Netty Ng; Eddie Ramirez

Subject: Re: Drives not being detected

Hi John,

I tied off with Dave regarding your drives.

Four of the five drives sent are recognized by the interface. In reviewing the log files, the drives are clean and do not show any errors or problems.

Only 1 drive had trouble being recognized by the interface. This drive requires further analysis. We are working on it and will provide an update as soon as possible.

Thanks and Best Regards,

Anik

On Tue, Dec 13, 2011 at 2:14 PM, John Dotson <jdotson@equuscs.com> wrote:

Dave,

Have you had a chance to analyze the drives? Do you have any questions that I can answer for you?

John

From: Will Wu

Sent: Friday, December 09, 2011 5:33 PM

To: 'Dave M Rollings'; Tim Poor

Cc: Anik Rubalcava-Capretta; John Dotson; John W Bornholdt; Netty Ng; Eddie Ramirez

Subject: RE: Drives not being detected

Hi Dave,

Shipped today
Here is the tracking number

1Z68W0A40166225183

Should get there on Monday

Thanks

From: Dave M Rollings [mailto:dave.m.rollings@seagate.com]

Sent: Friday, December 09, 2011 9:07 AM

To: Tim Poor

Cc: Anik Rubalcava-Capretta; John Dotson; John W Bornholdt; Netty Ng; Eddie Ramirez; Will Wu

Subject: Re: Drives not being detected

Hi Tim,

Thanks for the update. I will look for the drives on Monday.

Have a nice weekend.

dave

Dave Rollings
Field Applications Engineering
Seagate Technology
10200 S. De ANZA Blvd,
Cupertino, Ca 95014
Cell 408 218 3013

On Thu, Dec 8, 2011 at 9:53 PM, Tim Poor <TPoor@equuses.com> wrote:

Anik/Dave,

The drives did not make it out of our facility tonight, so they will ship tomorrow for Monday morning delivery.

Thank you,

Tim

From: Anik Rubalcava-Capretta [mailto:anik.rubalcava-capretta@seagate.com]
Sent: Thursday, December 08, 2011 5:29 PM
To: Tim Poor; Dave M Rollings
Cc: John Dotson; John W Bornholdt; Netty Ng; Eddie Ramirez
Subject: Re: Drives not being detected

Hi Tim,

Please ship 2-5 failing drives to the following address:

Seagate Technology
Attn: Dave Rollings
10200 South De Anza Blvd.
Cupertino, CA 95014

Thanks and Best Regards,

Anik

On Thu, Dec 8, 2011 at 3:01 PM, Tim Poor <TPoor@equuscs.com> wrote:

Anik,

We are building up seven of the systems for our large customer with 36 of the ST3000DM001 3TB drives in each system. We have had a number of hard drives that aren't recognized by the system at boot. Some drives will be recognized sporadically during multiple reboots, but others are not recognized as all. As a part of our troubleshooting process, we have moved the failed drives to a standard desktop system based on an Intel branded motherboard to see if the drive is recognized. Some of these drives are also not being recognized by the Intel board.

We would like to overnight a sampling of these failed drives to you to check the SMART system logs for any failure flags.

This level of hard drive failures is a severe concern for us, and we need to get to the bottom of this as quickly as possible.

Please let me know who/where we need to ship these drives for analysis.

Thank you,

Tim

Timothy Poor

Director, Field Application & Sales Engineering

Equus Computer Systems, Inc.

5801 Clearwater Drive

Minnetonka, MN 55343

O: 612-617-4317

F: 612-617-6298

tpoor@intequus.com

--

Best Regards,

Anik

Anik S. Rubalcava-Capretta
Sr. Customer Technical Support Engineer
Mobile: 949.315.1951
Email: Anik.Rubalcava-Capretta@seagate.com

--
Best Regards,

Anik

Anik S. Rubalcava-Capretta
Sr. Customer Technical Support Engineer
Mobile: 949.315.1951
Email: Anik.Rubalcava-Capretta@seagate.com

--
Best Regards,

Anik

Anik S. Rubalcava-Capretta
Sr. Customer Technical Support Engineer
Mobile: 949.315.1951
Email: Anik.Rubalcava-Capretta@seagate.com

--
Best Regards,

Anik

Anik S. Rubalcava-Capretta
Sr. Customer Technical Support Engineer
Mobile: 949.315.1951
Email: Anik.Rubalcava-Capretta@seagate.com

FED_SEAG0072642**Metadata**

Attach Counts	0	ORIGINAL
CC	John W Bornholdt <john.w.bornholdt@seagate.com>;Keith Myers <keith.r.myers@seagate.com>;Dave M Rollings <dave.m.rollings@seagate.com>	ORIGINAL
Confidentiality	Confidential	USER
Custodian	Rollings_Dave	ORIGINAL
Custodian Other	Rollings_Dave	ORIGINAL
DATECREATED	9/16/2016	ORIGINAL
DATELASTMOD	9/16/2016	ORIGINAL
DATERECEIVED	12/15/2011	ORIGINAL
DATESENT	12/15/2011	ORIGINAL
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FileName	Re- Drives not being detected[16].eml	ORIGINAL
FILESIZE	49604	ORIGINAL
FROM	Anik Rubalcava-Capretta <anik.rubalcava-capretta@seagate.com>	ORIGINAL
LastAccessDate	9/17/2016 12:00 AM	ORIGINAL
LastAccessedTime	6:29 AM	ORIGINAL
MD5 Hash	F175E6282F0F5255C7A4DBC756299C7B	ORIGINAL
Message_ID	<CADRoF7W+eCYWd9xF209mPgecjWn-wriexY0xWxWLweKz-9Ofvg@mail.gmail.com>	ORIGINAL
OrgFolder	\\Rollings_Dave\Gmail\Dave_Rollings_Gmail-1\Dave_Rollings_Gmail_dave.m.rollings@seagate.com_1.mbox\	ORIGINAL
RecordType	E-MAIL	ORIGINAL
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TIMERECEIVED	11:05 AM	ORIGINAL
TIMESENT	11:05 AM	ORIGINAL
TO	Mike S Carlow <mike.s.carlow@seagate.com>	ORIGINAL

EXHIBIT 37

Subject: Fwd: Agenda for QIR Executive Reviews, Oct 30-31
From: Andrei Khurshudov <andrei.khurshudov@seagate.com>
To: Dmitriy Y Vassilyev <dmitriy.y.vassilyev@seagate.com>
FAITH for Internal FA (LO) - 10Oct12.xlsx

data for the failure pareto sample size reduction study...

Regards,

Andrei Khurshudov, Ph.D
Sr. Director

Cloud Storage Quality Engineering
Seagate Technology

T 720.684.2656
F 720.684.1128
C 303.652.7577

andrei.khurshudov@seagate.com

389 Disc Drive • Longmont, CO
80503 • USA

----- Forwarded message -----

From: **Chris G Labbe** <chris.g.labbe@seagate.com>
Date: Sun, Oct 21, 2012 at 9:13 PM
Subject: Re: Agenda for QIR Executive Reviews, Oct 30-31
To: Andrei Khurshudov <andrei.khurshudov@seagate.com>

Here's our daily report on the 90 day inventory of failures by source.

Mostly, the operation of concern is CST2, which indicates the QA version of GIO, usually run as LODT.

In the recent history, Grenada is the highest volume by far. But Grenada is not very stable right now. It could be a good study since it would represent the extreme ... could we still catch the existing problems even with nearly constant shifts in performance.

Otherwise, Pharaoh is the other candidate. More mature and stable. If sampling doesn't reveal the same answer here, then it might not on any other program :)

Chris Labbe
Sr. Director
Analysis & Solutions Engineering
Seagate Technologies

"Always A Solution"

Thai cell (66) 086-892-2810
Thai office (66) 04-470-3933
US vmail 1 (720) 864-1012

On Tue, Oct 16, 2012 at 5:34 AM, Andrei Khurshudov <andrei.khurshudov@seagate.com> wrote:

Hi Chris,
it was good talking to you at the Tech Review (and in the Airport).
We will now start working on the project that we have discussed. When possible, we would like to receive the following actual data for whatever product you chose (or, for several products):

- List of ODT failures that went into FA (I presume, all ODT failures) in the order of failure events
- for each failure, please provide the identified failure mode

Our goal will be - for now - to check if it is possible to do FA on half of these drives WITHOUT LOSING INFO ABOUT FAILURE PARETO, EXCURSIONS, etc.
In other words, could we reduce the ODT FA sampling rate by 2x without any loss in fidelity of data and conclusions?

I will keep you updated on our progress and please correct me if my goal definition is not too accurate. thanks!

Regards,

Andrei Khurshudov, Ph.D
Sr. Director

Cloud Storage Quality Engineering
Seagate Technology

T 720.684.2656
F 720.684.1128
C 303.652.7577

andrei.khurshudov@seagate.com

389 Disc Drive • Longmont, CO
80503 • USA

On Mon, Oct 15, 2012 at 4:40 PM, Chris G Labbe <chris.g.labbe@seagate.com> wrote:

Todd,

no timeline attached.

Chris Labbe
Sr. Director
Analysis & Solutions Engineering
Seagate Technologies

"Always A Solution"

Thai cell (66) 086-892-2810
Thai office (66) 04-470-3933
US vmail 1 (720) 864-1012

On Mon, Oct 15, 2012 at 1:47 PM, Todd A Stute <todd.a.stute@seagate.com> wrote:

I've set a tentative agenda for the QIR Project Executive Reviews, scheduled for Oct 30/31.

In preparation for those reviews, please complete the following:

1. By Oct 19th, let me know whether you accept the date and time slot I've assigned your project. Let me know who will be presenting the project review to the executives (speaker).
2. By Oct 26th, provide me with a short powerpoint presentation that will be used in the review. Since we have 12+ projects to review in under than 120 minutes of valuable executive time, we have to keep them all short and concise (6-8 minutes max!!!). To that end, please adhere to the following:
 1. Limit your presentation to 2-3 slides in addition to your project charter slide(s) you'll find in the attached presentation. I can include more slides in the backup but we need to keep the talking slides to 2-3 per project review.
 2. On these slides, emphasize your project status (what you've accomplished or are planning to do shortly) and key objectives(what

you plan to accomplish through this project). Also, highlight anywhere that you'd like executive feedback on (issues, challenges, roadblocks). Finally, provide a general timeline for project completion.

3. I've included a template for your convenience.

Any questions or concerns, let me know ASAP.

--

Todd A. Stute
Seagate Corporate Quality
(952) 402-5981

FED_SEAG0006442**Metadata**

Attach Counts	1	ORIGINAL
Attach_ID	SG_CTRL0010706	ORIGINAL
Attachment_Name	FAITH for Internal FA (LO) - 10Oct12.xlsx	ORIGINAL
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FILESIZE	8882585	ORIGINAL
FROM	Andrei Khurshudov <andrei.khurshudov@seagate.com>	ORIGINAL
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OrgFolder	Khurshudov_Andrei\Andrei_Khurshudov-3\Andrei_Khurshudov_andrei.khurshudov@seagate.com_2.mbox\Khurshudov_Andrei\Andrei_Khurshudov-3\	ORIGINAL
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Relativity Image Count	4	ORIGINAL
Relativity Native Time Zone Offset	-8.00	ORIGINAL
TIMERECEIVED	7:31 AM	ORIGINAL
TIMESENT	7:31 AM	ORIGINAL
TO	Dmitriy Y Vassilyev <dmitriy.y.vassilyev@seagate.com>	ORIGINAL

EXHIBIT 38

Subject: Re: FW: RN 316 - not detecting disk 3TB HDD, Case ID 21090433.
From: Dave M Rollings <dave.m.rollings@seagate.com>
To: Albert Langarica <alangerica@netgear.com>

Hi Albert,

I do not see any of the attachments. What FW was on the ST3000DM001 drives that failed in the field? Our current shipping FW is CC27. I see that John was successful with an older FW CC43. I know it looks like we got out of sequence going from CC43 to CC27 but just look at the last digit. We went from a 3 to a 7.

In your logs I see the drive is showing a drive ready error and aborting a READ CMD.

Is this a boot up issue or a drive drop issue where the drive goes away?

Are you able to confirm this issue is only seen with a specific FW?

Depending on the answers to my questions we may need to replicate at Netgear and get a bus trace.

dave

Dave Rollings
Field Applications Engineering
Seagate Technology
10200 S. De ANZA Blvd,
Cupertino, Ca 95014
Cell 408 218 3013

On Mon, May 13, 2013 at 11:00 AM, Albert Langarica <alangerica@netgear.com> wrote:

Hi Dave,

When you get a chance take a look at the issue below.

-Albert

On 5/13/13 5:27 AM, "Marcus Fairbrother" <mfairbrother@netgear.com> wrote:

>Hi John / Albert

>

>Did you have a look at this?

>I see in logs a lot of

>

>May 05 15:00:09 nas-27-5B-76 kernel: ata5.00: exception Emask 0x0 SAct
>0x0 SErr 0x0 action 0x0
>May 05 15:00:09 nas-27-5B-76 kernel: ata5.00: irq_stat 0x40000001
>May 05 15:00:09 nas-27-5B-76 kernel: ata5.00: failed command: READ DMA
>May 05 15:00:09 nas-27-5B-76 kernel: ata5.00: cmd
>c8/00:08:18:00:00/00:00:00:00/e0 tag 0 dma 4096 in
>May 05 15:00:09 nas-27-5B-76 kernel: res
>51/04:08:18:00:00/00:00:00:00/e0 Emask 0x1 (device error)
>May 05 15:00:09 nas-27-5B-76 kernel: ata5.00: status: { DRDY ERR }
>May 05 15:00:09 nas-27-5B-76 kernel: ata5.00: error: { ABRT }
>May 05 15:00:09 nas-27-5B-76 kernel: ata5.00: configured for UDMA/133
>May 05 15:00:09 nas-27-5B-76 kernel: ata5: EH complete
>
>Do you think Seagate could tell if that firmware could cause an issue?
>
>Ales
>I am sorry L1 have picked up the case and gave some not so good advise
>about return to supplier. Can you step in and explain looks like old
>firmware on the Seagate drives is causing an issue. He can look to Seagte
>website I believe there is method to upgrade those drives
>
>Regards
>Marcus
>
>
>
>-----Original Message-----
>From: Ales Mudrunka
>Sent: 06 May 2013 10:05
>To: Marcus Fairbrother; John Chin; Davin Oishi; Josua Braun; Albert
>Langarica
>Cc: Richard Jonker
>Subject: RE: RN 316 - not detecting disk 3TB HDD, Case ID 21090433.
>
>Hi Marcus,
>
>Please see attached logs. Case is open under ID: 21090433.
>
>Regards
>Ales
>
>
>-----Original Message-----
>From: Marcus Fairbrother
>Sent: Thursday, May 02, 2013 10:58 AM
>To: Ales Mudrunka; John Chin; Davin Oishi; Josua Braun; Albert Langarica

>Cc: Richard Jonker
>Subject: RE: RN 316 - not detecting disk 3TB HDD
>
>Hi Ales
>
>Can we ask customer to start a case at my.netgear.com Also can we have a
>set of logs from the unit when they have the 250GB and 3 x 3TB
>
>The firmware is different that what John tested so maybe seagte have
>changed something
>
>Thanks
>Marcus
>
>-----Original Message-----
>From: Ales Mudrunka
>Sent: 02 May 2013 09:50
>To: John Chin; Davin Oishi; Marcus Fairbrother; Josua Braun; Albert
>Langarica
>Cc: Richard Jonker
>Subject: RE: RN 316 - not detecting disk 3TB HDD
>
>Hi All,
>
>Please find attached label of HDD. Thank you.
>
>Regards
>
>Aleš
>
>
>-----Original Message-----
>From: John Chin
>Sent: Wednesday, May 01, 2013 12:27 AM
>To: Davin Oishi; Ales Mudrunka; Marcus Fairbrother; Josua Braun; Albert
>Langarica; John Chin
>Cc: Richard Jonker
>Subject: Re: RN 316 - not detecting disk 3TB HDD
>
>I just tried it with a RN316 4x ST3000DM001 with firmware CC43 and it saw
>all 4 disks I had installed.
>
>Thanks
>John
>
>On 4/30/13 3:14 PM, "Davin Oishi" <doishi@netgear.com> wrote:

>
>>Albert,
>>Can you through a Seagate DM 3TB drive into a RN316 quickly and see if
>>it is detected?
>>
>>Ales,
>>Is it possible to take a photo of the entire hard drive label? So we
>>know the firmware version on the hard drive as well as the lot numbers.
>>I'm assuming when you swapped out and tested different drives that the
>>"other"
>>drives were in the same bay (so we know the bay works).
>>
>>-Davin
>>
>>
>>
>>
>>On 4/30/13 6:14 AM, "Ales Mudrunka" <amudrunka@netgear.com> wrote:
>>
>>>
>>>Just one more update regarding this case. It works fine with 2TB
>>>Samsung as well.
>>>
>>>Regards
>>>Ales
>>>
>>>
>>>-----Original Message-----
>>>From: Richard Jonker
>>>Sent: Tuesday, April 30, 2013 1:33 PM
>>>To: Ales Mudrunka
>>>Cc: Marcus Fairbrother; Josua Braun; Davin Oishi
>>>Subject: Re: RN 316 - not detecting disk 3TB HDD
>>>
>>>Adding Josua and Davin
>>>
>>>Regards,
>>>
>>>Richard Jonker
>>>NETGEAR
>>>
>>>On 30 apr. 2013, at 13:23, "Ales Mudrunka" <amudrunka@netgear.com>
>>>wrote:
>>>
>>>> Hi Marcus,
>>>>

>>>> Can you please advice? Customer bought RN316, SN: 3C613300009EF,
>>>>separately 4x HDD 3TB Seagate ST3000DM001. System is showing "NO HDD
>>>>DETECTED". They tried factory default etc. without success. They have
>>>>been successful to upgrade to 6.0.4 with 250 GB HDD and this HDD is
>>>>working ok. 80GB HDD was ok as well. It looks that system cannot
>>>>recognize 3TB HDD. Thank you.

>>>>

>>>> Regards

>>>> Ales

>>>>

>>>> -----Original Message-----

>>>> From: p.masar@vlp.cz [mailto:p.masar@vlp.cz]

>>>> Sent: Tuesday, April 30, 2013 11:33 AM

>>>> To: Ales Mudrunka

>>>> Subject: Dotaz z webu - po nákupu: RN 316

>>>>

>>>> Kontaktní osoba : Pavel Masar

>>>> Kontaktní email : p.masar@vlp.cz

>>>> Kontaktní telefon : 724285636

>>>> Předmět : RN 316

>>>> Zpráva : Dobrý den,

>>>>

>>>> zakoupili jsme Ready Nas 316 a k němu 4 disky 3TB Seagate

>>>>ST3000DM001, dle HCL listu na

>>>>http://www.netgear.com/images/HCL_RN6_0401201318-73531.pdf. Jsou

>>>>tedy být certifikovány výrobcem pro tento nas.

>>>> Disky však nejsou detekovány. Provedl jsem upgrade fw na poslední

>>>>verzi 6.0.4 pomocí menšího disku 250GB, ale ty velké stále nejsou v

>>>>systemu. Co s tím ???

>>>>

>>>> Vyzkoušel jsem i jiný disk 3TB seagate a také není detekován.

>>>>

>>>> Serial nr toho nasu je 3C613300009EF.

>>>>

>>>> Děkuji,

>>>>

>>>> Pavel Masar

>>>>

>>>>

>>>>

>>>> Datum: 30.04.2013

>>>> Čas: 11:32

>>>>

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EXHIBIT 39

Sender: Anik Rubalcava-Capretta <anik.rubalcava-capretta@seagate.com>
Sent: Wednesday, October 8, 2014 11:13:28 AM
Recipient: tom.barrett@seagate.com
Cc: ramin.esmailzadeh@seagate.com
Subject: UC Irvine - Background Info.
Attachments: LogFilesAnalysis.pdf

Hi Tom,

Ramin and I spoke this morning and he mentioned we will have a call this afternoon to review UC Irvine.

Just to provide some background on UC Irvine.

They are using our Grenada Classic drive.

9YNxxx is Grenada Classic and the drives they are using are 2011 and 2012 vintage drives.

Early 2012 vintage Grenada has a 2x Field return rate over current drives based on Standard OEM field data (Feb-June 2012 RR on All OEM was ~0.7% vs. Oct-Nov 2013 RR of 0.3% on Grenada BP). This is due to a multitude of issues, including particle improvement mitigation actions, out gassing, an improved air bearing design (internal) on Grenada BP, FW fixes etc.

The drives in general they are using have bad quality.

Since these are desktop drives there are no accelerometers on the drive. Unfortunately, there are bugs with the internal log files and it appears to record the vibration, but these are random numbers. The data recorded is bogus data.

Also, because of a known issue with SMART log reporting of T transferred and POH on Grenada drives with POH reporting and total reads and writes it is impossible to get an accurate reading on TB written / Read per year. (For desktop: Workload Rate Limit: 55 TB/yr, avg, For Nearline: 550 TB/yr, avg)

The data in the log files for desktop is inaccurate. I am working with the Design Center to see if this can be addressed.

If we send a couple of these drives for full Failure Analysis, most probably the results will indicate that they are early vintage Grenada with poor quality.

UCI is using desktop drives in a 3U 36 enclosure, desktop drives are specified to be used as 1 drive/system. Based on this information I put together the attached report. Since the data in the log files is inaccurate it is not possible to add more detail to this report.

Look forward to speaking with you later today.

Best Regards,

Anik

Anik Rubalcava-Capretta

Seagate Technology | Customer Technical Support

Email: Anik.Rubalcava-Capretta@seagate.com | Mobile: 949.315.1951

EXHIBIT 45

From: Paul A Steele <paul.a.steele@seagate.com>
Subject: Re: Grenada 3TB at-risk population still in warranty: Please Provide Estimated Cost Analysis
To: Alan W Clark <alan.w.clark@seagate.com>

Hi Alan,

SRS cost is \$340 per recovery assuming we pay shipping cost on the in bound and populate the recovered data to Evault cloud. We are about to launch this service in late June so the timing is really good.

Regards,
-PS

Paul Steele
Seagate Recovery Services
10321 West Reno Avenue
Oklahoma City, OK 73127
(952) 232-9332

On Tue, May 26, 2015 at 2:59 PM, Alan W Clark <alan.w.clark@seagate.com> wrote:

I'm out of pocket today, but looks like we need a back of the envelope assessment of what this could cost in terms of providing replacements, handling calls and providing free data recovery. We should also look at our capacity to handle the incremental call volumes, may need to add headcount in all 3 regions or consider an emergency spike outsource to CSS.

Bea, can you lead pulling together the various pieces here. I'm reminded of the Moose thing from a few years ago, although I think that was a much bigger deal than this Grenada thing.

Need to run this as a high priority.

Ac

Sent from my iPad

Begin forwarded message:

From: Joni J Clark <joni.j.clark@seagate.com>
Date: May 26, 2015 at 12:50:07 PM PDT
To: Bruce Serpa <bruce.serpa@seagate.com>, Daniel J Tschudi <daniel.j.tschudi@seagate.com>, Alan W Clark <alan.w.clark@seagate.com>, Tomer Hagay <tomer.hagay@seagate.com>
Cc: Kimberly Myers <kimberly.myers@seagate.com>
Subject: Grenada 3TB at-risk population still in warranty: Please Provide Estimated Cost Analysis

Hello SRS, CSO and CSS Teams,

For the Grenada issue in the channel we have 850K drives still in warranty that may be returned due to contamination issue. For Apple it's more like 135K units. Total at risk: 985K

Rocky is asking for a plan to support these customers if the Apple recall happens. There are two paths we need to underpin for him. The cost if we only support the Apple recall and the cost if we extend to channel customers who may also be affected by the issue.

1. Apple Recall Customers: Seagate Cloud Back-Up Services free for 1 year to upload important data while systems are being updated/reworked.

- Up to 3TBs of Seagate Back-up Cloud Services for a period of 12 months
- How and what data to back up instructionsBased on 135K at risk
X 3TB = \$xxx cost to Seagate

2. Channel Customer who contacts STX with failed units under warranty - (must meet usage requirement - no enterprise workloads supported on desktop models). Free Data recovery if drive fails while under warranty and customer has no back-up.

- Free data recovery services if drive is in warranty and customer has no backup.
- CS team must verify with model number, and manufacturing date range, usage environment. Cut off is 1348-7 using the label date code on drive.
- Based on worst case scenario of 850K units: \$XXX cost to Seagate

Please let me know by end of day what kind of cost this might be to Seagate

for your respective areas. Send me a note if you have other questions.

Thank you,

Joni.

Joni Clark | Seagate Technology
Global NAS Segment Manager
720-684-1145 | joni.j.clark@seagate.com

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FED_SEAG0055784**Metadata**

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Custodian Other	Clark, Alan	ORIGINAL
DATERECEIVED	5/26/2015	ORIGINAL
DATESENT	5/26/2015	ORIGINAL
DOEXT	eml	ORIGINAL
DOCTYPE	Internet Message (MIME)	ORIGINAL
FED_BEGATTACH	FED_SEAG0055784	ORIGINAL
FED_ENDATTACH	FED_SEAG0055786	ORIGINAL
FileName	Re Grenada 3TB at-risk population still in warranty Please Provide Estimated Cost Analysis.eml	ORIGINAL
FILESIZE	16033	ORIGINAL
FROM	Paul A Steele <paul.a.steele@seagate.com>	ORIGINAL
MD5 Hash	A0F727ED43847EB0BA56EC27855BE97E	ORIGINAL
Message_ID	<CAB5KgWhaWMV6g151qanHPDZtsryjLcgA5nZ0SZGh9cujkYk-vA@mail.gmail.com>	ORIGINAL
OrgFolder	040956\Clark, Alan\Alan_Clark-1\Alan_Clark_alan.w.clark@seagate.com_0.mbox\Clark, Alan\Alan_Clark-1\	ORIGINAL
RecordType	E-MAIL	ORIGINAL
Relativity Image Count	3	ORIGINAL
Relativity Native Time Zone Offset	-8.00	ORIGINAL
TIMERECEIVED	1:15 PM	ORIGINAL
TIMESENT	1:15 PM	ORIGINAL
TO	Alan W Clark <alan.w.clark@seagate.com>	ORIGINAL

EXHIBIT 48



Backblaze Analysis

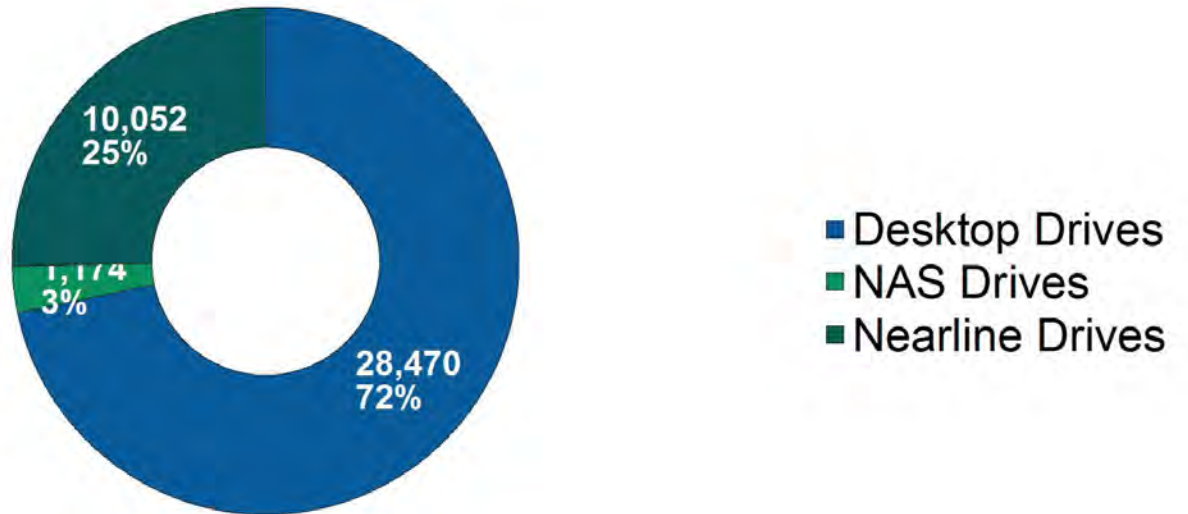
January 2015

Roger Eckrode

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FED_SEAG0025567

Drives Implemented at Backblaze by Type



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2

FED_SEAG0025568

Nearline Models

Model	Capacity	Number of Drives	Average Age (Years)	Annual Failure Rate	RPM	Cache (MB)	Interface (Gb/s)	Warranty(Years)	MTBF (hours)	Load/Unload
HGST Megascale 4000 HMS5C4040ALE640	4TB	6,949	0.4	1.40%	5700	64	6	3	800K	600,000
HGST Megascale 4000.B HMS5C4040BLE640	4TB	3,103	0.7	0.50%	5700	64	6	3	800K	300,000

Expected Workload:

- Low application workload cloud storage
- Massive scale out
- Data warehousing & mining
- Disk to disk backup & archive
- Less than 180TB scenarios

NAS Models

Model	Capacity	Number of Drives	Average Age (Years)	Annual Failure Rate	RPM	Cache (MB)	Interface (Gb/s)	Warranty(Years)	MTBF (hours)	Load/Unload
Western Digital Red WDC WD30EFRX	3TB	859	0.9	6.90%	5400	64	6	3	1M	600,000
Western Digital Red WDC WD40EFRX	4TB	45	0.8	0.00%	5400	64	6	3	1M	600,000
Western Digital Red WDC WD60EFRX	6TB	270	0.1	3.10%	5400	64	6	3	1M	600,000

Expected Workload:

- 24x7
- 1-5 Bay NAS

Desktop Models Part 1

* = Information not published

Model	Capacity	Number of Drives	Average Age (Years)	Annual Failure Rate	RPM	Cache (MB)	Interface (Gb/s)	Warranty (Years)	MTBF (hours)	Load/Unload
HGST Deskstar 7K2000 HDS722020ALA330	2TB	4,641	3.9	1.10%	7200	32	3	3	*	300,000
HGST Deskstar 5K3000 HDS5C3030ALA630	3TB	4,595	2.6	0.60%	5000	32	6	3	*	600,000
HGST Deskstar 7K3000 HDS7203030ALA640	3TB	1,016	3.1	2.30%	7200	64	6	3	*	600,000
HGST Deskstar 5K4000 HDS5C4040ALE630	4TB	2,598	1.8	0.90%	5000	32	6	3	*	600,000
Seagate Barracuda 7200.11 ST31500341AS	1.5TB	306	4.7	23.50%	7200	32	6	3	750K	*
Seagate Barracuda LP ST31500541AS	1.5TB	1,505	4.9	9.50%	5900	32	3	3	*	*
Seagate Barracuda 7200.14 ST3000DM001	3TB	1,163	2.2	43.10%	7200	64	6	2	*	300,000

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Desktop Models Part 2

* = Information not published

Model	Capacity	Number of Drives	Average Age (Years)	Annual Failure Rate	RPM	Cache (MB)	Interface (Gb/s)	Warranty (Years)	MTBF (hours)	Load/Unload
Seagate Barracuda XT ST33000651AS	3TB	279	2.9	4.80%	7200	64	6	5	750K	300,000
Seagate Barracuda XT ST4000DX000	4TB	177	1.7	1.10%	7200	128	6	1	*	*
Seagate Desktop HDD.15 ST4000DM000	4TB	12,098	0.9	2.60%	7200	64	6	2	*	300,000
Seagate Desktop ST6000DX000	6TB	45	0.4	0.00%	7200	128	6	2	1.4M	*
Toshiba DT01ACA Series DT01ACA300	3TB	47	1.7	3.70%	7200	64	6	2	*	300,000

Expected Workload and Notes:

- Drives marked in red were only ever sold as external storage (removed from enclosure)
- Desktop, External Storage, Desktop Raid

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FED_SEAG0025572

FED_SEAG0025567**Metadata**

Attach Counts	0	ORIGINAL
AUTHOR	Angela D. Villarreal	ORIGINAL
Confidentiality	Highly Confidential	USER
Custodian	Clark, Alan	ORIGINAL
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DATELASTMOD	1/23/2015	ORIGINAL
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Old FedBegProd	FED_SEAG0007318	ORIGINAL
OrgFolder	Clark, Alan\Alan, Clark-1\Alan, Clark, alan.w.clark@seagate.com_1.mbox\Clark, Alan\Alan, Clark-1\	ORIGINAL
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Relativity Image Count	6	ORIGINAL
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TimeLastMod	1:48 PM	ORIGINAL
TITLE	Corporate Template Instructions Use these instructions when developing slide decks using the officia	ORIGINAL

EXHIBIT 51

Seagate Reliability Campaign

Anchor article initial outline

I. Introduction: Asking the Wrong Question

- A. Stuff happens. To wit, the IBM Deathstar of 2001.
- B. Backblaze 1/21/15: "What is the Best Hard Drive?"
- C. What happened?
- D. Ask a better question: "What Makes a Hard Drive Reliable?"

II. Elements of Reliability

- A. Definition for Seagate: "As few customer returns as possible. We strive to keep it down to tenths of a percent on customer returns." [Paul]
- B. Metrics
 - 1. MTBF/AFR for long-term reliability
 - a) address variations in measurement*
 - 2. DPPM during integration
 - 3. all metrics tied to triggers; when trigger reached, shipments stop until fixed
 - 4. nothing goes to mass production unless all metrics being met

III. Elements of a Reliable Drive

- A. Firmware
 - 1. Super parity
 - a) first on Constellation ES.3 (2012); spawned from UCSC research in 2009*
 - b) ES.3 became Enterprise Capacity 3.5*
 - c) Super parity part of SAS controller*
 - 2. Directed offline scan (DOS)
 - a) runs offline scans when storage access not needed; Barracuda 7200.10*

b) Sandeep: "If you have a highly sequential workload [like surveillance], then DOS is more effective than super parity. If you have highly random, then super-parity becomes more effective."

3. Temperature compensation [need more info]

B. The role of environment

1. temperature

2. power/voltage

3. vibration

a) on-drive vibration sensors

b) motor balancing

c) lower RPMs

4. duty cycle & number of users

C. The role of workload

D. Relationship between increasing capacity and reliability

1. capacity trends

a) SMR/higher tracks per inch

b) more platters

c) more HDDs per enclosure

2. higher density / smaller features means more engineering

3. Chris: "With higher aerial density, you tend to have less signal coming from the head, so our recording channel has to improve. It sees more of the good signal that comes from the head and less of the noise that it generates."

4. SMR and sequentializing data will reduce seeks and vibration, also lowers power/temp

5. because reliability INCREASES with capacity, SMR/high-cap now bridging the divide between desktop and enterprise

6. Mary: "More and more, certainly beyond 8TB, it's really not a desktop PC/client kind of drive anymore."

IV. Building Reliability From the Ground Up

A. Product Development Process (Seagate's phase-gate)

1. 1.5 years from start to ship
2. spans four Seagate design centers (MN, CO, Singapore, South Korea)
3. load shifts from development to factory over time
4. number of drives made increases with each phase
5. MTBF also increases for each phase
6. extreme rigor applied at Seagate, but customers might catch other issues; Paul: "We run these in a very stressful environment that sits at high temperature. Drives are operating all the time, 24 hours a day and for weeks, when we're qualifying this. Doing random, sequential seeks, writing and reading constantly. Much more than the customer would ever do."
7. key scrutiny on DPPM
8. Seagate often extracts drive logs from customers' data, runs bus traces, etc. to assemble a workload for more thorough testing; sometimes even tunes drives for that workload

B. Assigning of drive to product family based on results

1. Can have one product span 7 product segments, for example; same heads and media, just different tweaks and components

V. Reliable Results

A. Studies beyond Backblaze

B. Backblaze: what the press *didn't* bother to cover

1. 6TB Seagate rocks: <https://www.backblaze.com/blog/our-6tb-hard-drive-face-off-revisited/>
2. the 4TB is showing only a 2.6% AFR
3. the 3TB Barracuda XT had a 2.1% lower AFR than the WD Red 3TB

C. The real authorities: OEMs

1. #1 at Apple for past 6 years
 2. #1 at Dell for past 10 years
 3. Acer quality report
 4. [??] quality report
- D. Close up with Seagate's internal test results

VI. Conclusion

- A. taking a snapshot view of any point in the market is inherently limited and potentially damaging to your business
- B. first rule of journalism: always question your source
- C. second rule: get the whole story
- D. the single affected drive arrived post-flood amid extreme market shortage and was never meant for a data center environment
- E. overwhelming evidence shows that Seagate quality and reliability are at exceptional highs now
- F. get the right drive for environment and workload
- G. expect the story to only keep getting better, because Seagate's pursuit of perfection never stops
 1. most ongoing improvement comes within the first 3 months after shipping, but the process keeps going
 2. it's about gaining additional margin; great drives always getting better

FED_SEAG0025642**Metadata**

Attach Counts	0	ORIGINAL
AUTHOR	William	ORIGINAL
Confidentiality	Highly Confidential	USER
Custodian	Bradfield_Jennifer	ORIGINAL
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DATELASTMOD	5/11/2015	ORIGINAL
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EXHIBIT 52

Product Failure Rate Trends and the Role of Workload Stress

Andrei Khurshudov

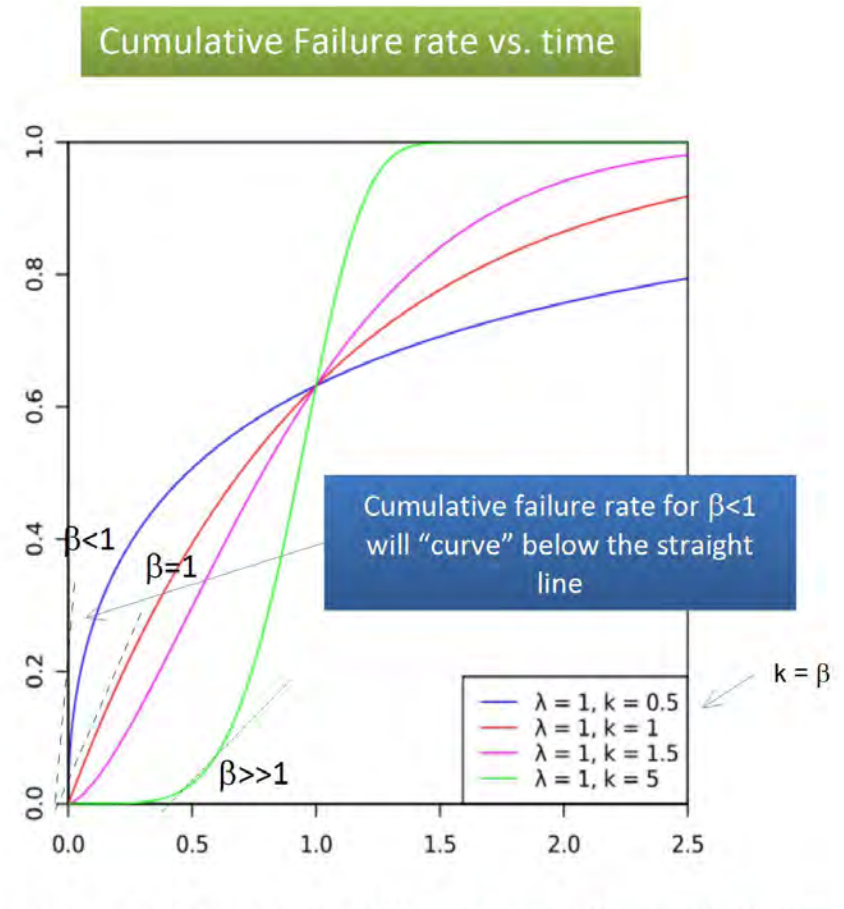
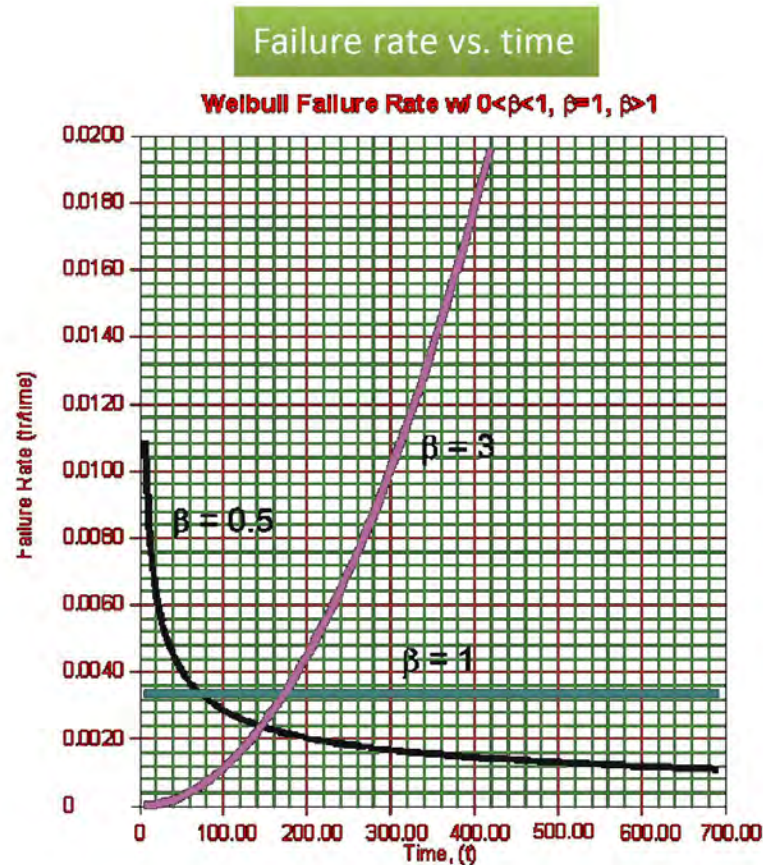
LCO

2012

Objectives

- We always presume that the failure rate of our products declines over time (as the infant mortality population fails)
 - The above assumption corresponds to Weibull $\beta < 1$, which we use in our calculations and AFR/MTBF projections ($\beta = 0.55$ is typically used)
 - Therefore, it is presumed that products will improve reliably over time
 - Products with $\beta > 1$ are typically suffering from “wearout” phenomenon, which is highly undesirable
- The main objective of this study is to understand if the above assumptions are correct and how the higher workload stress is impacting the above dependencies
- Also, since the workload stress will only increase with time, this could allow us to make some future predictions

Failure Rate vs. Time



- A value of $\beta < 1$ indicates that the failure rate decreases over time. This happens if there is significant "infant mortality", or defective items failing early and the failure rate decreasing over time **as the defective items are weeded out of the population**
- A value of $\beta = 1$ indicates that the failure rate is constant over time. This might suggest random external events are causing mortality, or failure
- A value of $\beta > 1$ indicates that the failure rate increases with time. This happens if there is an "aging" process (wearout), or parts that are more likely to fail as time goes on

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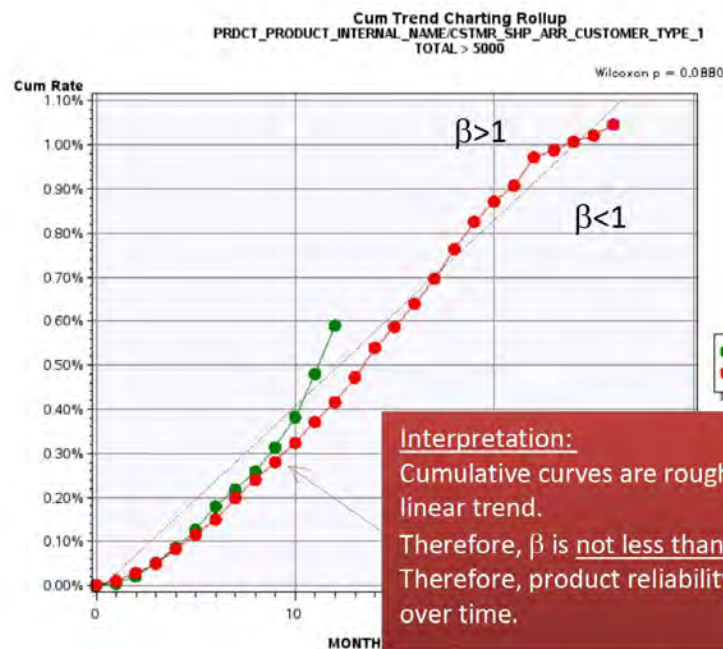
Andrei.Khurshudov@seagate.com

Analysis Methodology

- Total cumulative return rates for most of our products were obtained from eCube
 - This is the link to all the materials used: [link](#)
- All plots were *analyzed visually* using the rules described on the previous page to categorize each product as “having $\beta < 1$ ” or not having it. Also, cases of clear $b > 1$ were marked and counted
 - A typical period of 36 month was used to derive this conclusion
 - It is recommended to repeat this analysis formally (with data fitting)
- In some cases, products were excluded from this analysis if the service period was too short, data were unclear or noisy, or for some other (noted) reason
- Later, every product family was ranked (arbitrarily) in terms of their perceived workload stress from 1 (lowest workload) to 5 (highest workload)

Data Analysis Example:

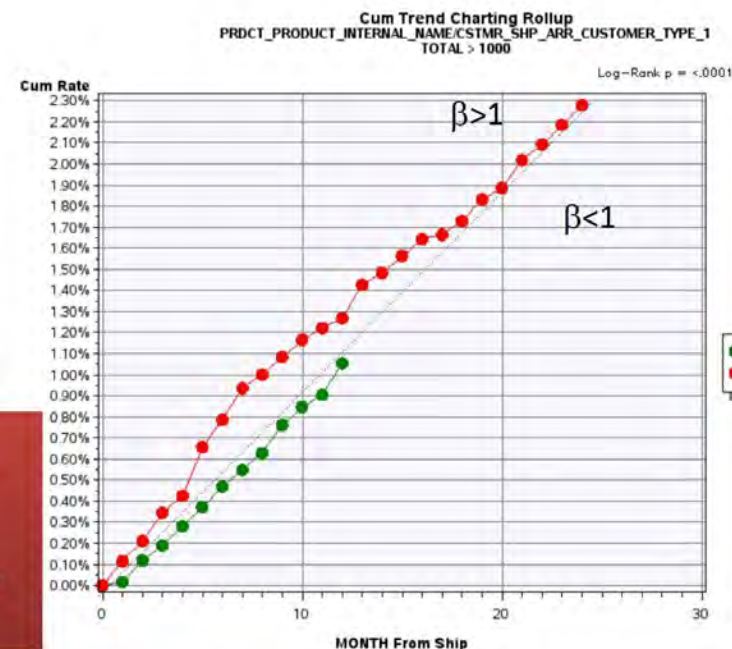
MC: 2.5" / 10K rpm



Interpretation:
Cumulative curves are roughly following the linear trend.
Therefore, β is not less than 1.
Therefore, product reliability doesn't improve over time.

eCube Created: 02MAY12 22:16

Note: Incomplete Data Points have been excluded

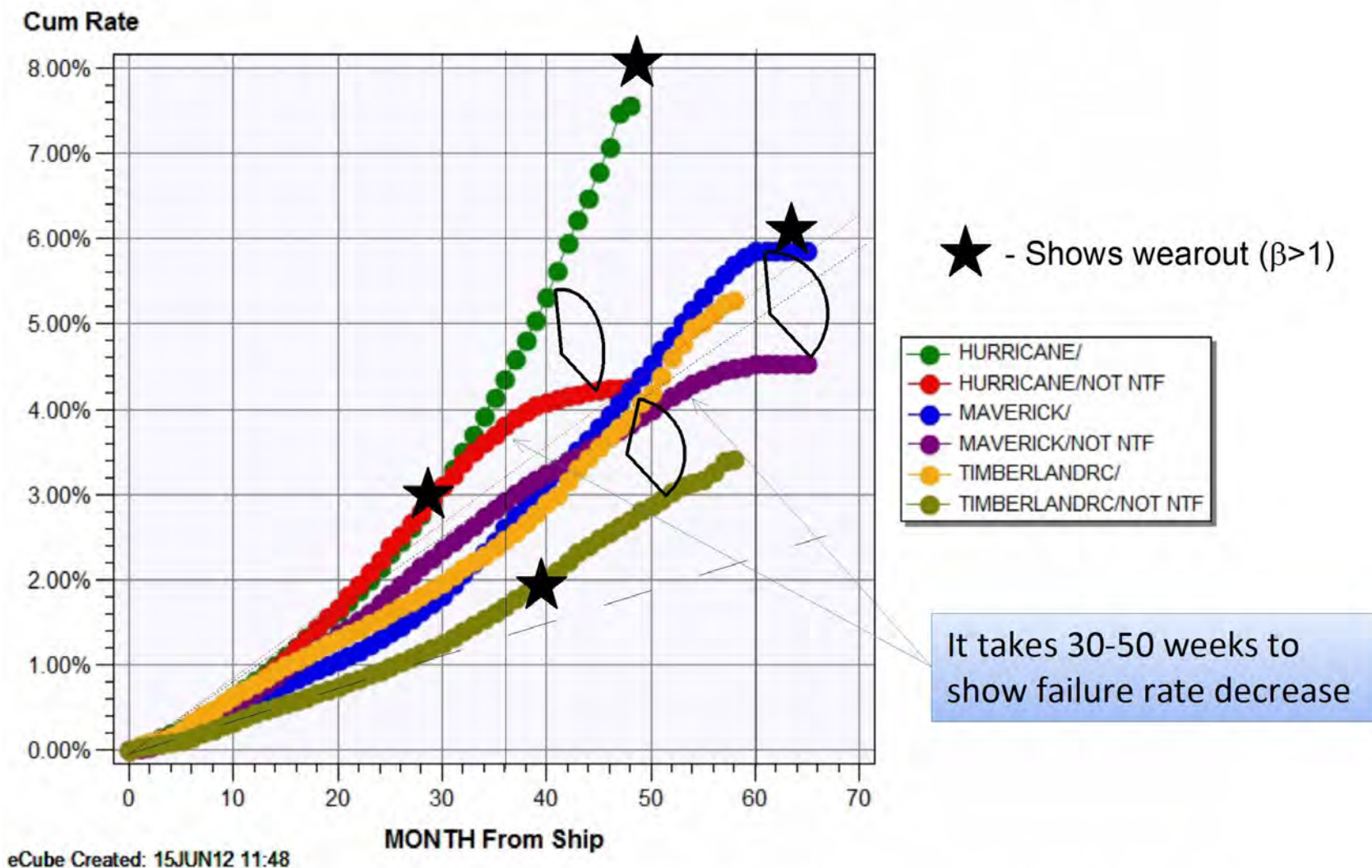


eCube Created: 02MAY12 22:16

Note: Incomplete Data Points have been excluded

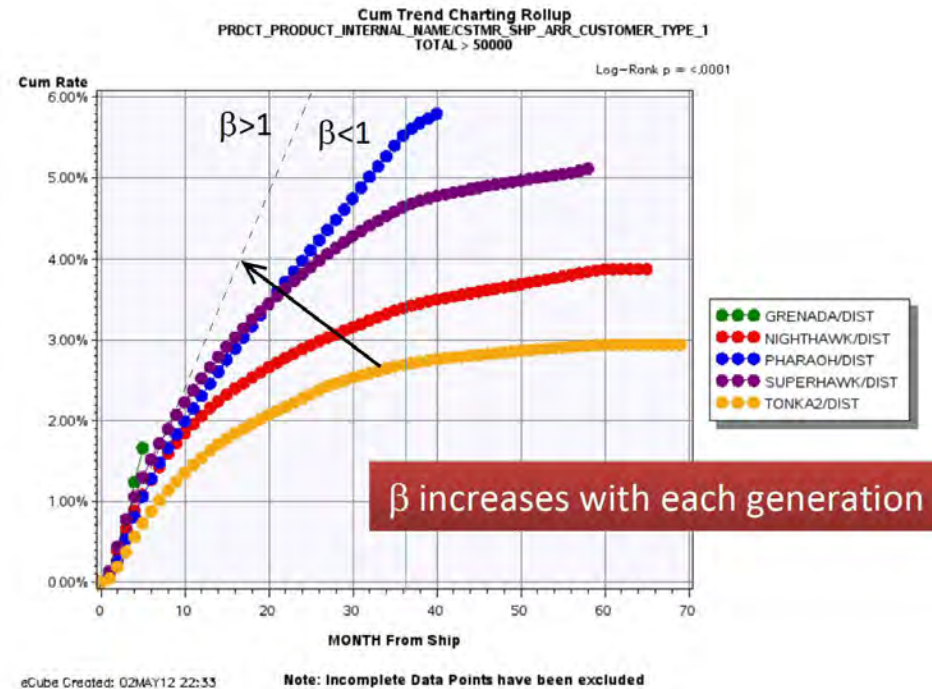
Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	0/2	0/2
Constant ($\beta = 1$) or increasing ($\beta > 1$)	2/2	2/2

Methodology Check: Removing NTFs



- No evidence that removing NTFs changes result interpretation dramatically
- It is unclear why in case of Hurricane and Maverick, there is some noticeable increase in the number of NTFs starting 30-40 weeks

Product Evolution Example



- The above chart offers a good example of how the Weibull beta is shifting from lower value to $\beta=1$ over several generations of our Disti PS products
- While Tonka and Nighthawk was showing the behavior we expected to see with $\beta \ll 1$, Superhawk cum failure rate was *closer to straight line*, and Pharaoh's trend *looks almost straight* now ($\beta = 1$)
- We should wait until we could make a conclusion about Grenada
- **Need more data analysis to confirm this observation**

Summary of Results

Relative workload stress level (assigned by Andrei)

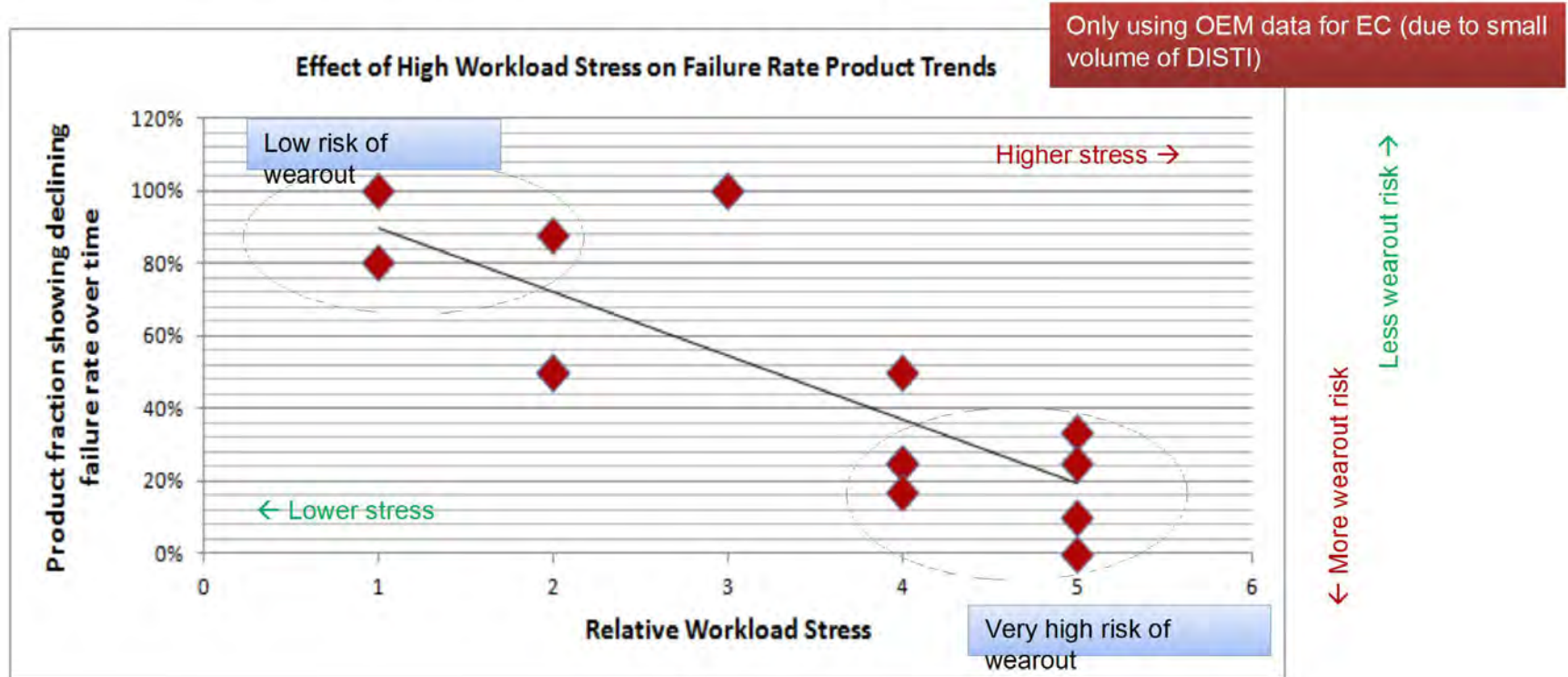
Average of OEM and Distribution values

Market	OEM products, $\beta < 1$ in 3 years	Distribution products, $\beta < 1$ in 3 years	Assumed workload (high = 5, low = 1)	Average
MC: 2.5" / 10K rpm	25%	25%	4	25%
MC: 2.5" / 15K rpm	33%	0%	5	17%
MC: 3.5" / 10K rpm	25%	75%	4	50%
MC: 3.5" / 15K rpm	0%	50%	5	25%
NL: 2.5" / 7200 rpm	0%	50%	5	25%
NL: 3.5" / 7200 rpm	0%	20%	5	10%
PS: 3.5" / 5900 rpm (Low Power)	50%	50%	2	50%
PS: 3.5" / 7200 rpm (Mainstream)	100%	100%	3	100%
PS: 3.5" / 7200 rpm (Performance)	100%	100%	3	100%
CE: 3.5" / 5900 rpm (DVR, LP)	0%	33%	4	17%
CE: 3.5" / 7200 rpm (DVR, Mainstream)	50%	50%	4	50%
NS: 2.5" / 5400 rpm	100%	75%	2	88%
NS: 2.5" / 7200 rpm	20%	80%	2	50%
NS: 2.5" (hybrid)	0%	100%	2	50%
Retails – Portable USB		80%	1	80%
Retails – Desktop USB		100%	1	100%
NS: 2.5" (Thin)	0%	0%	2	0%

Mechanically very challenging environment for super-thin laptops. Lots of mechanical stress and shock

- The above table summarizes all the observations
- “Average” rating represents the mathematical average of OEM and Distribution values
- High % values correspond to higher probability of “normal” behavior with reliability improving over life of the product
- Average for all the products is **about 50%**

Workload Stress Dependence



- According to the above chart, higher workload stress could be used as an explanation to the fact that some product families show constant or increasing failure rate over time (signatures of potential wearout)
 - Less than 50% of “high workload products” (stress level 4 and 5) show failure rate improvements over life
 - At the same time, 80%+ of “low stress products” show failure rate improvements over life

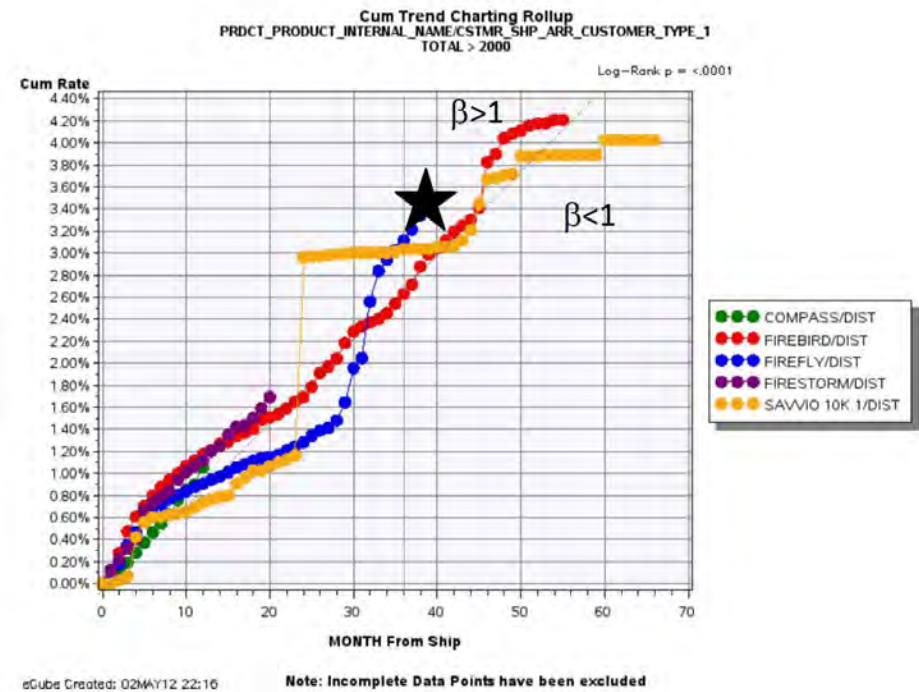
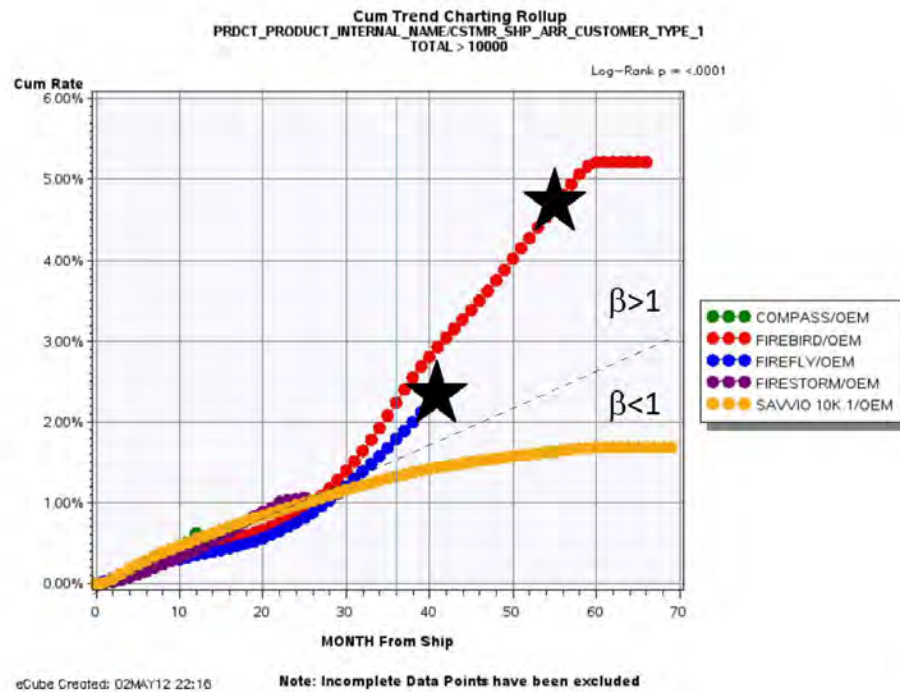
Conclusions

- About 50% of our products do not follow an expectation of declining failure rate (or, $\beta < 1$) with time. 30% of products show a signature of wearout.
 - This could serve as an evidence that our products don't have enough design margin
- It is possible that there is a correlation between the amount of workload stress and the product's propensity to show constant failure rate or wearout
 - MC and NL products, operating under higher workloads, show many more signatures of constant failure rate or even wearout than less stressed NS and SBS products
 - High workload seems to prevent failure rate from declining over time
 - More "focused and formal" analysis is needed to confirm this dependence
- Future will bring higher workload stress and, thus, higher risk of wearout
- Also, considering that we observe $\beta < 1$ in most of our internal tests (RDT, ORT), one could conclude that these relatively short tests do not necessarily predict well the long-term product reliability behavior
- The Weibull β values assumptions we are using for AFR/MTBF projections might need to be revisited upward to, possibly, $\beta = 1$.
- Longer-term reliability tests (~1 Year) might need to be introduced to gain more confidence in reliability projections

Backup Materials

MC: 2.5" / 10K rpm

★ - 2/4 Shows wearout ($\beta > 1$)



Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	1/4	1/4*
Constant ($\beta = 1$) or increasing ($\beta > 1$)	3/4	3/4

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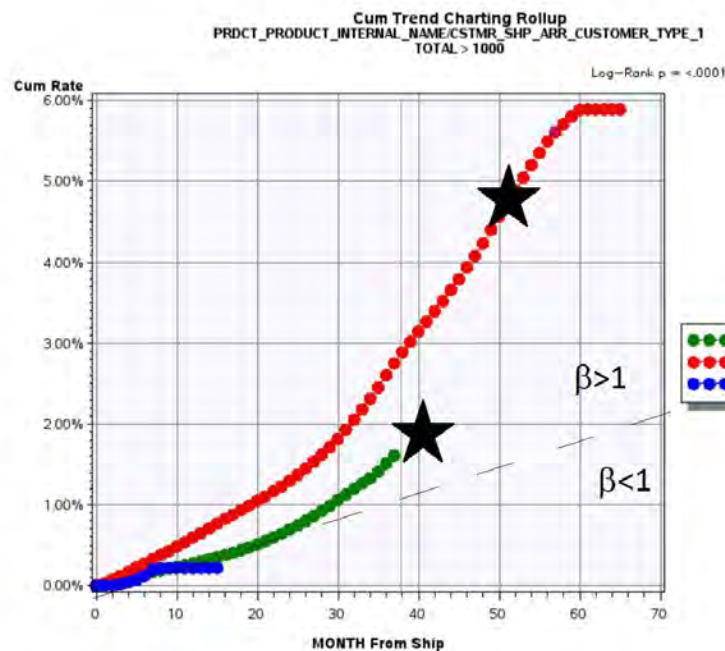
* Assume for Firestorm/DIST
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FED_SEAG0001862

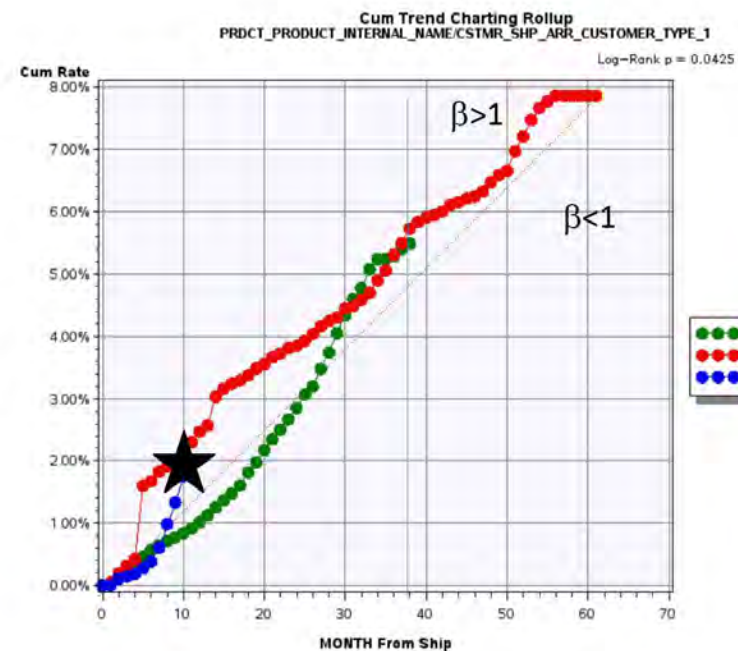
MC: 2.5" / 15K rpm

★ - 2/3 Shows wearout ($\beta > 1$)



eCube Created: 02MAY12 22:16

Note: Incomplete Data Points have been excluded



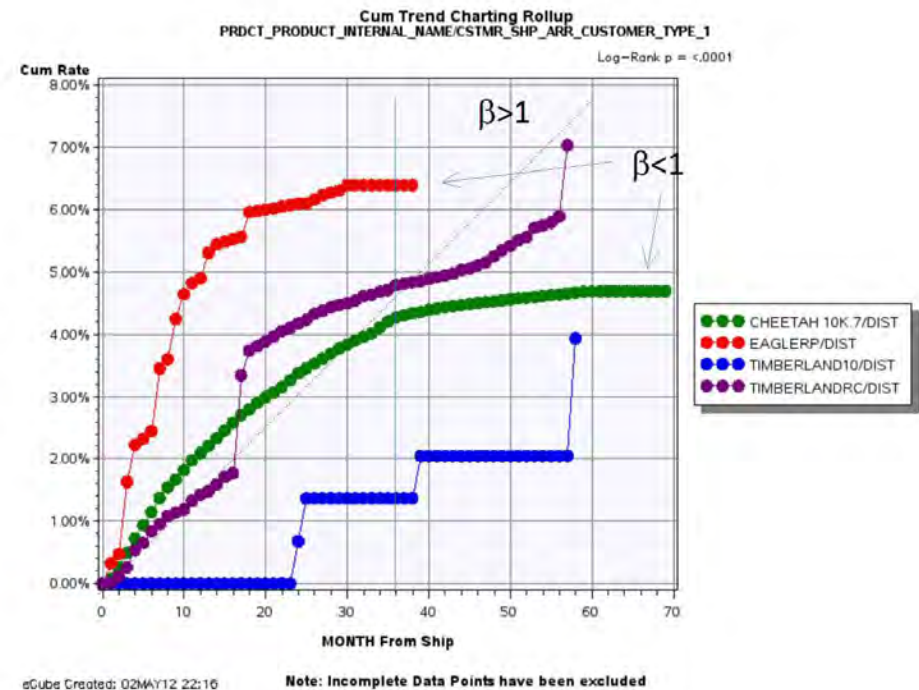
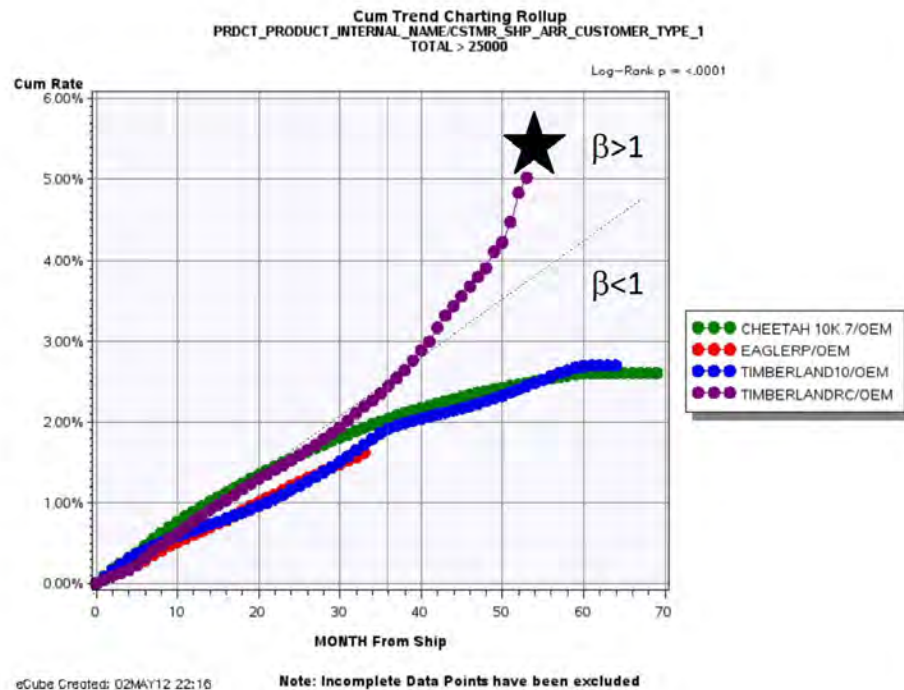
eCube Created: 02MAY12 22:16

Note: Incomplete Data Points have been excluded

Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	1/3	0/3
Constant ($\beta = 1$) or increasing ($\beta > 1$)	2/3	3/3

MC: 3.5" / 10K rpm

★ - ¼ Shows wearout ($\beta > 1$)



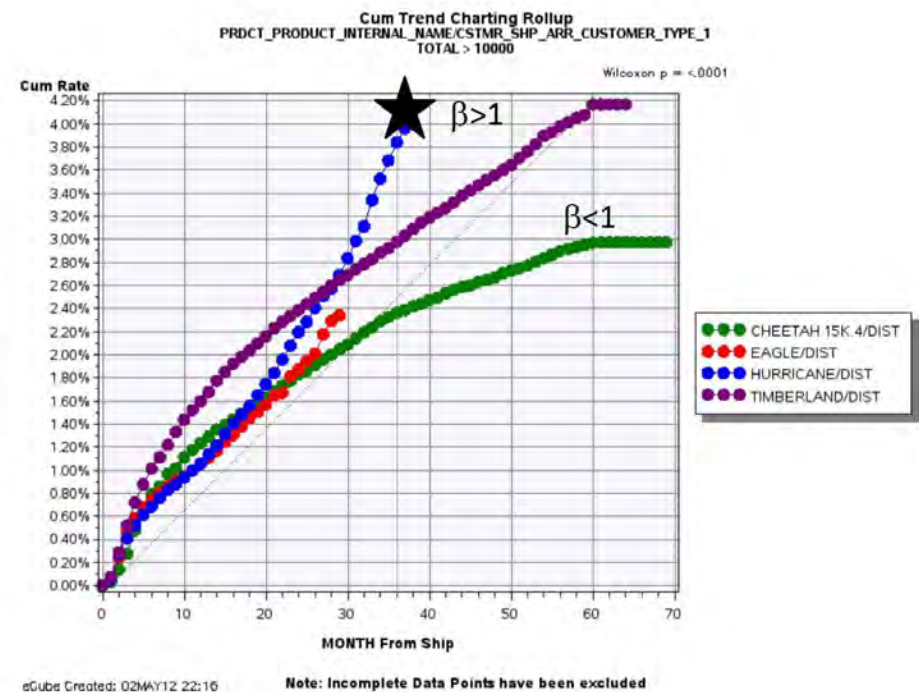
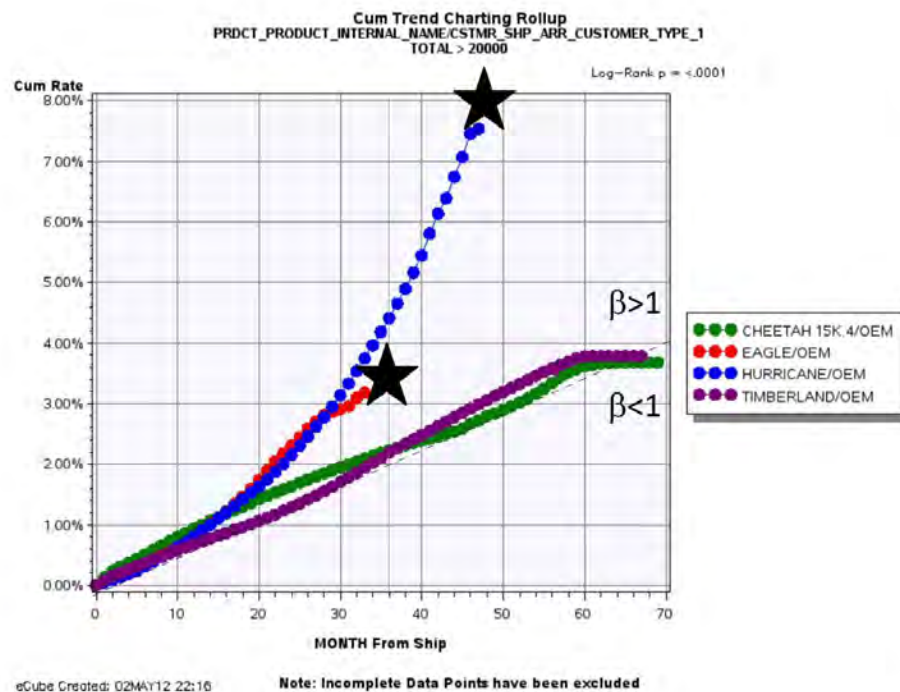
Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	1/4	3/4
Constant ($\beta = 1$) or increasing ($\beta > 1$)	3/4	1/4

* Cheetah 10.7/OEM

Timberland10/DIST – strange data

MC: 3.5" / 15K rpm

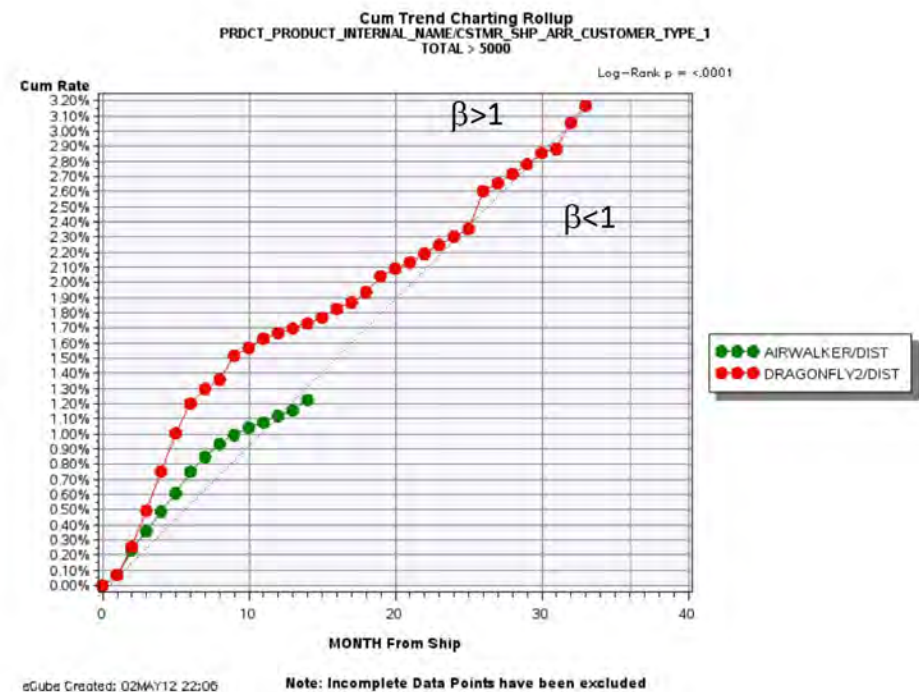
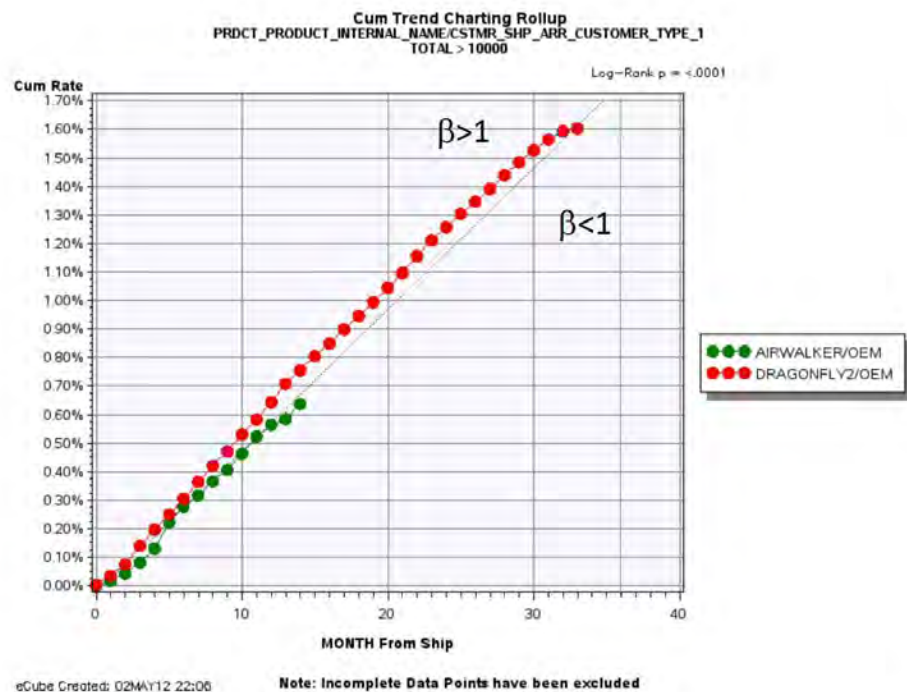
★ - 2/4 Shows wearout ($\beta > 1$)



Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	0/4	2/4
Constant ($\beta = 1$) or increasing ($\beta > 1$)	4/4	2/4

NL: 2.5" / 7200 rpm

★ - 0/2 Shows wearout ($\beta > 1$)

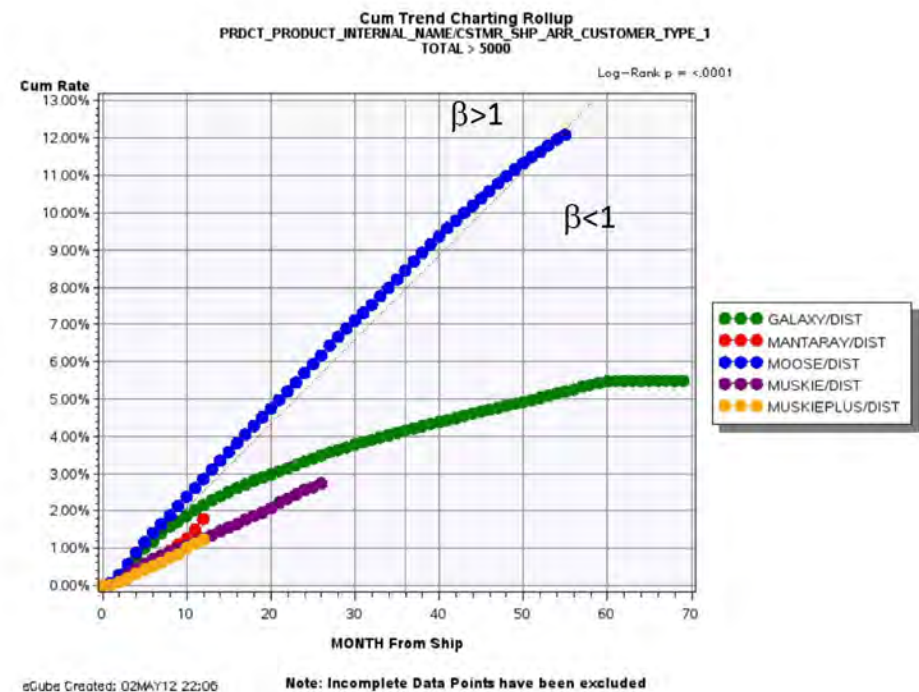
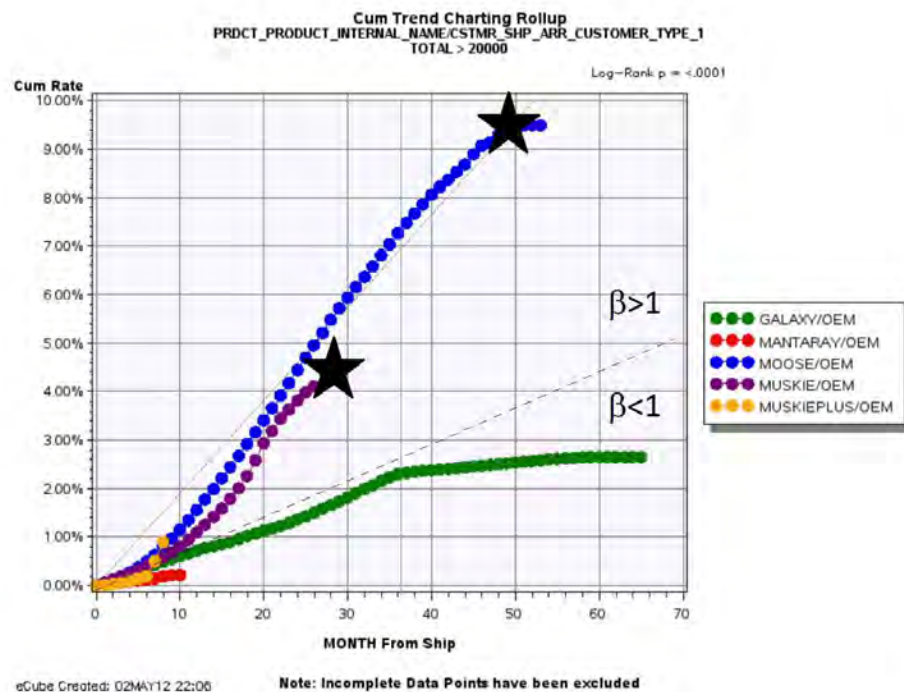


Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	0/2	1/2*
Constant ($\beta = 1$) or increasing ($\beta > 1$)	2/2	1/2

Dragonfly2/DIST – long-term shows $\beta = 1$

NL: 3.5" / 7200 rpm

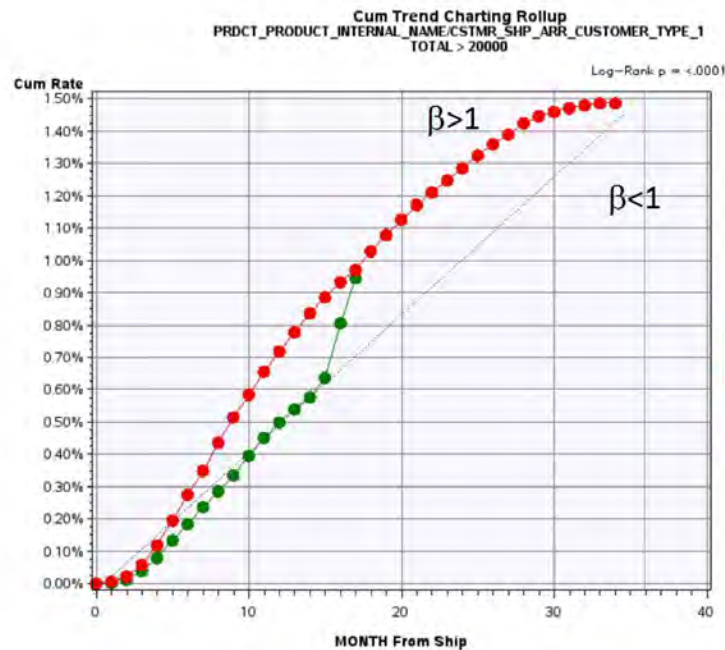
★ - 2/3 Shows wearout ($\beta > 1$)



Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	0/3	1/5
Constant ($\beta = 1$) or increasing ($\beta > 1$)	3/3	4/5

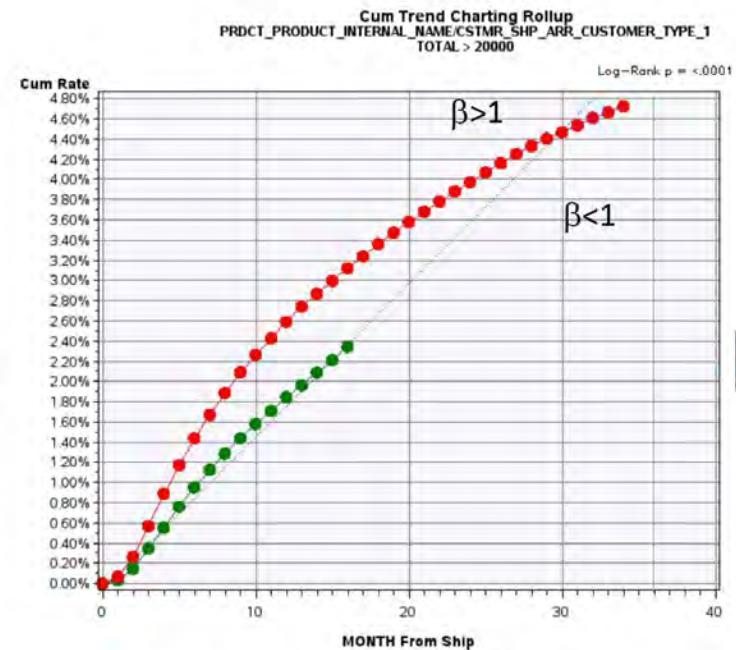
PS: 3.5" / 5900 rpm (Low Power)

★ - 0/2 Shows wearout ($\beta > 1$)



eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded



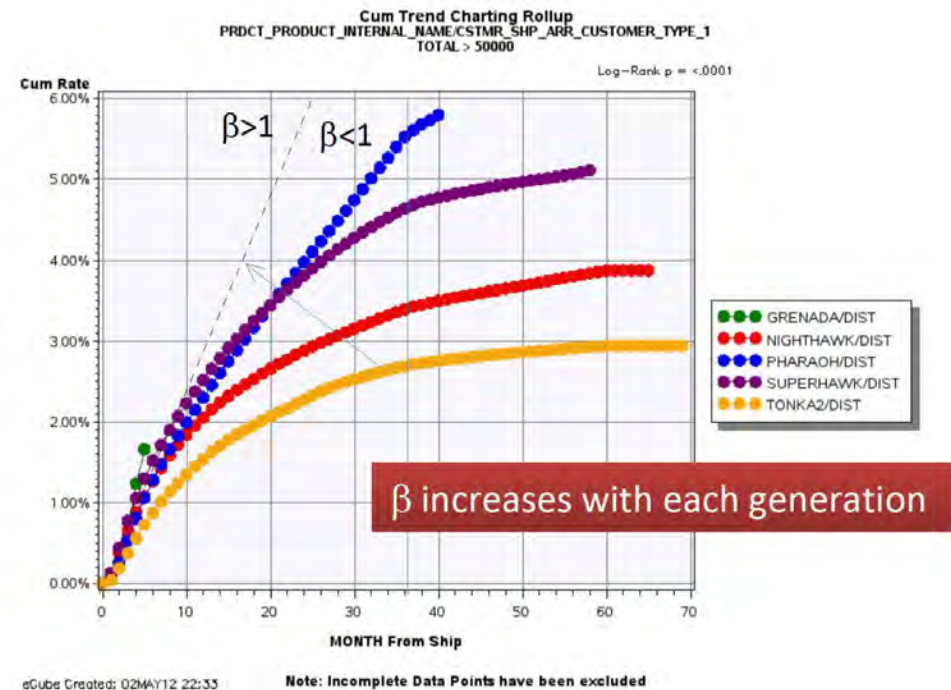
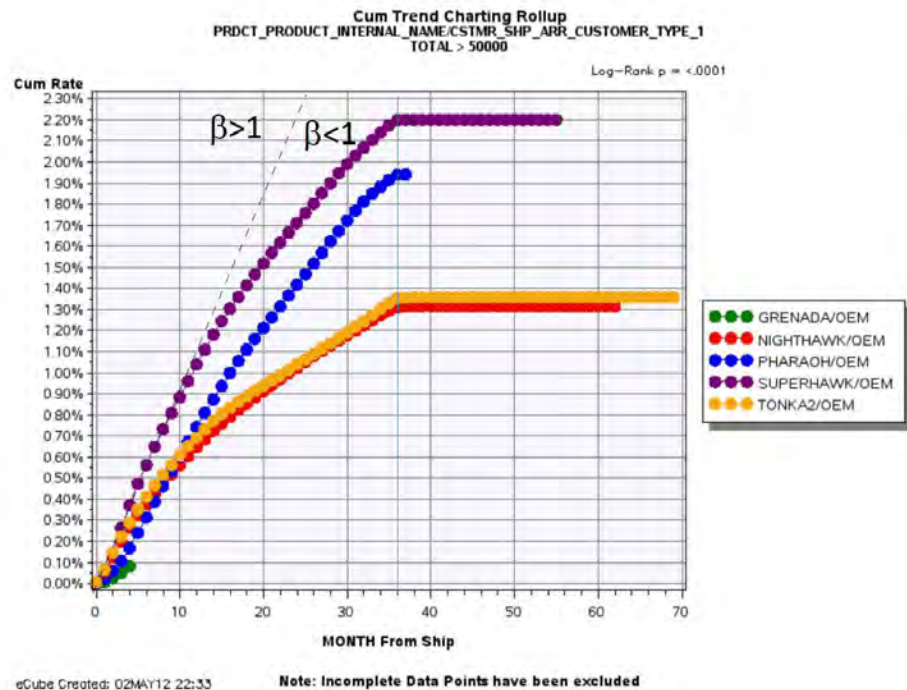
eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded

Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	1/2	1/2
Constant ($\beta = 1$) or increasing ($\beta > 1$)	1/2	1/2

PS: 3.5" / 7200 rpm (Mainstream)

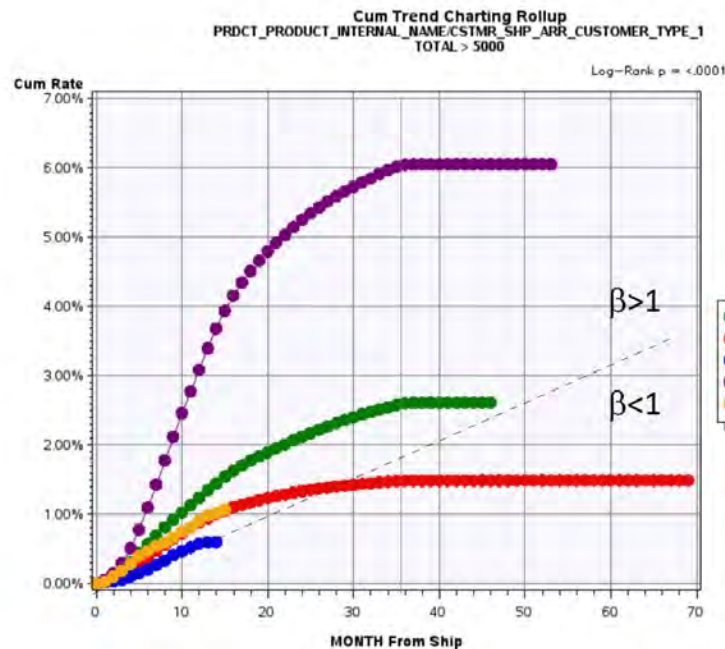
★ - 0/4 Shows wearout ($\beta > 1$)



Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	4/4	4/4
Constant ($\beta = 1$) or increasing ($\beta > 1$)	0/4	0/4

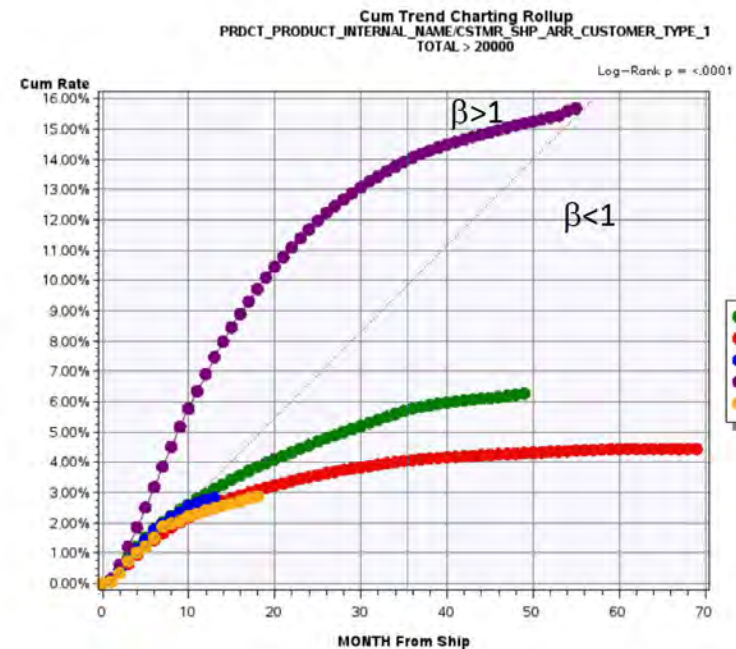
PS: 3.5" / 7200 rpm (Performance)

★ - 0/5 Shows wearout ($\beta > 1$)



eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded



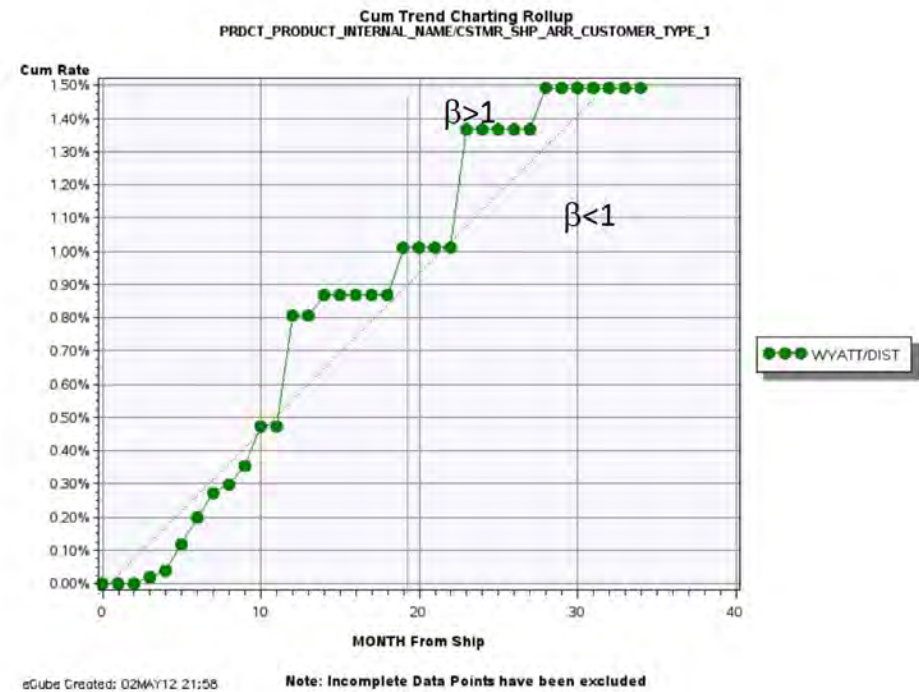
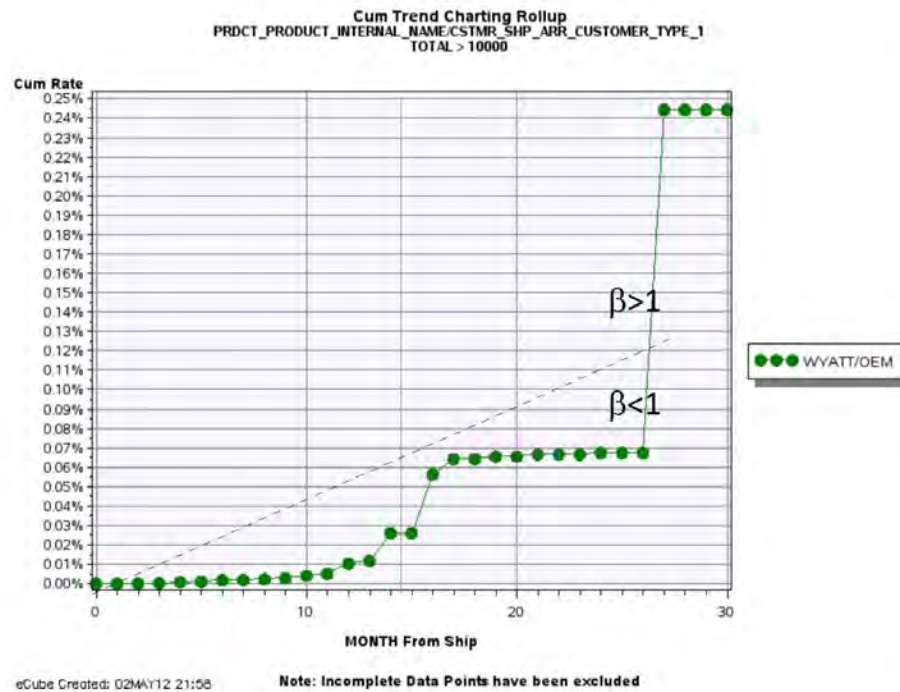
eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded

Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	4/4	5/5
Constant ($\beta = 1$) or increasing ($\beta > 1$)	0/4	0/5

CE: 2.5" / 7200 rpm (DVR)

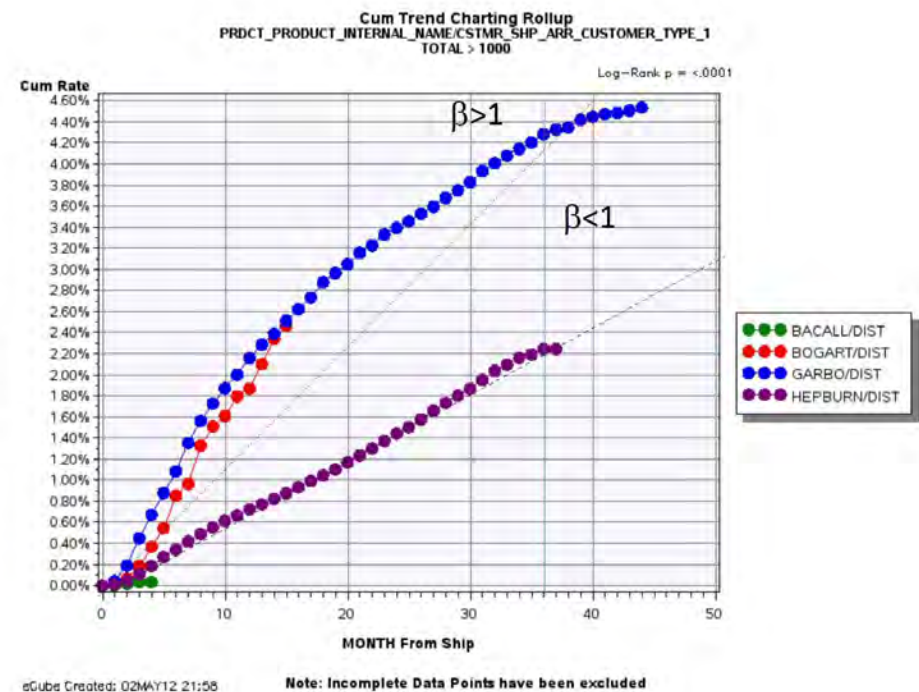
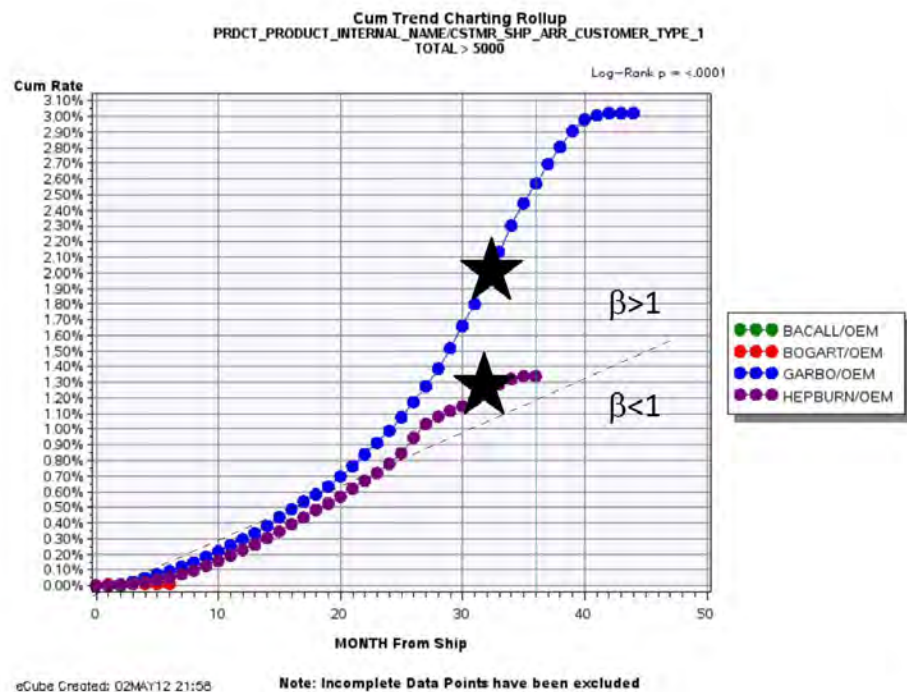
★ - Shows wearout ($\beta > 1$)



Too little data to make conclusions

CE: 3.5" / 5900 rpm (DVR, LP)

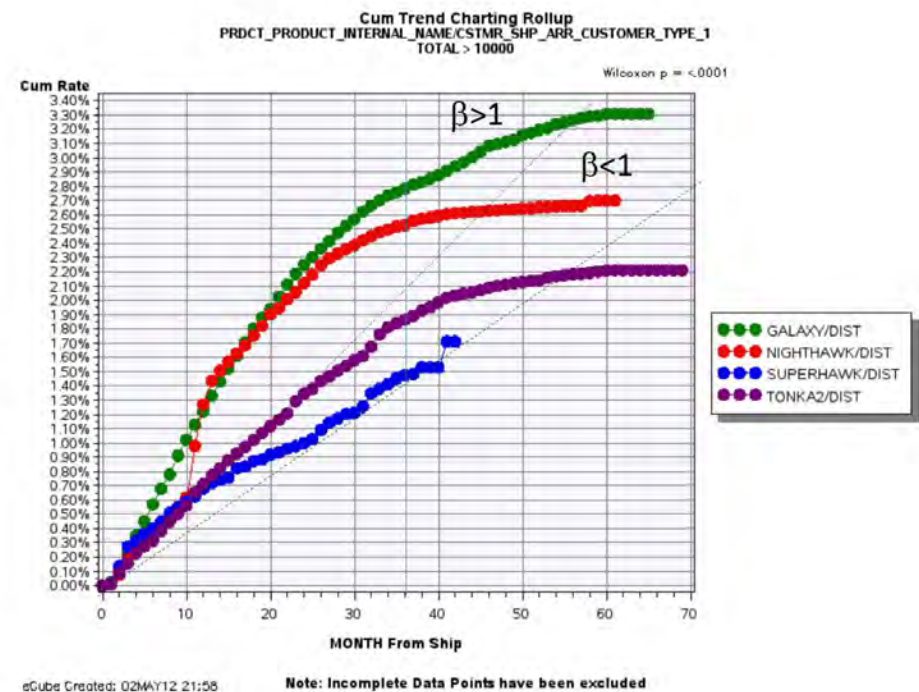
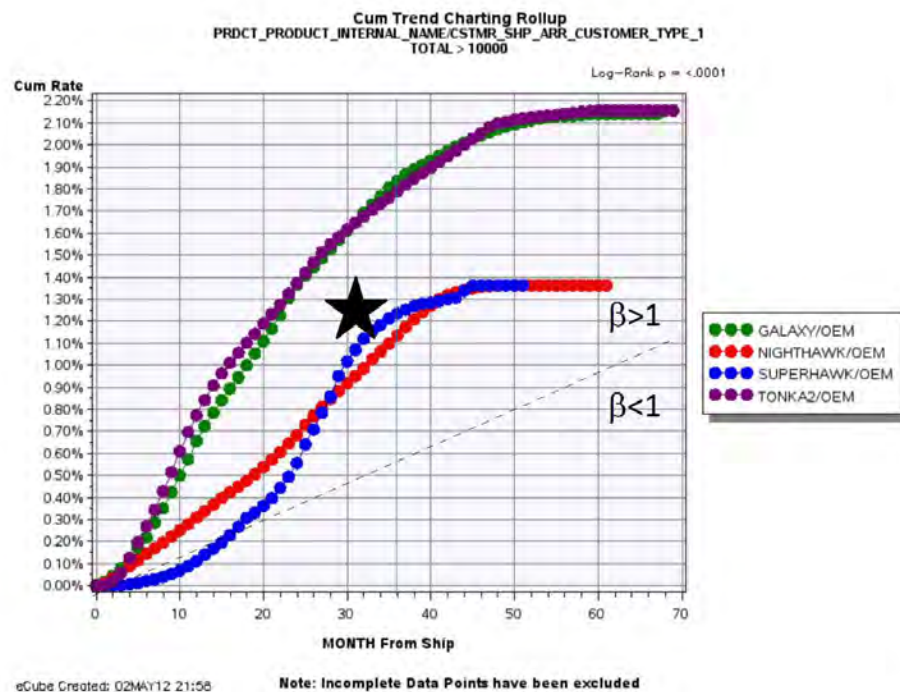
★ - 2/3 Shows wearout ($\beta > 1$)



Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	0/2	1/3
Constant ($\beta = 1$) or increasing ($\beta > 1$)	2/2	2/3

CE: 3.5" / 7200 rpm (DVR, Mainstream)

★ - ¼ Shows wearout ($\beta > 1$)



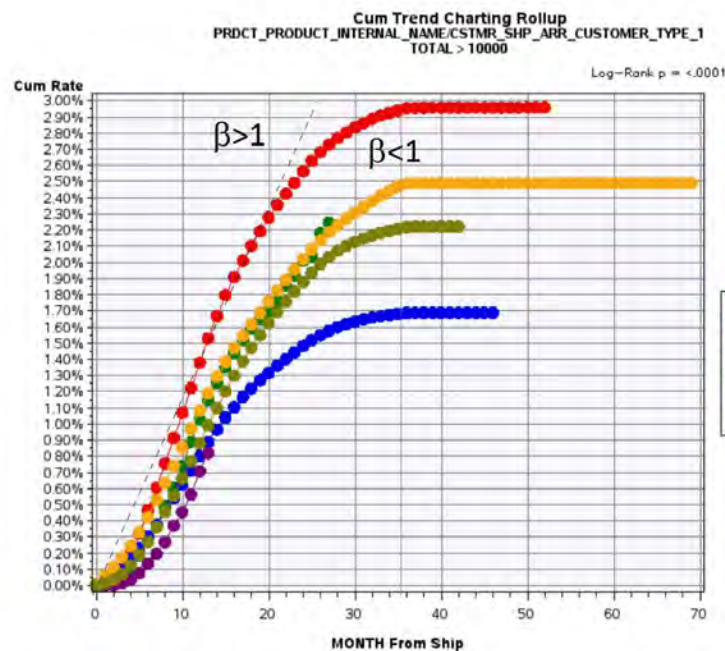
Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	2/4*	2/4*
Constant ($\beta = 1$) or increasing ($\beta > 1$)	2/2	2/4

* Galaxy barely qualifies

*Tonka2 barely qualifies. Nighthawk does not qualify.

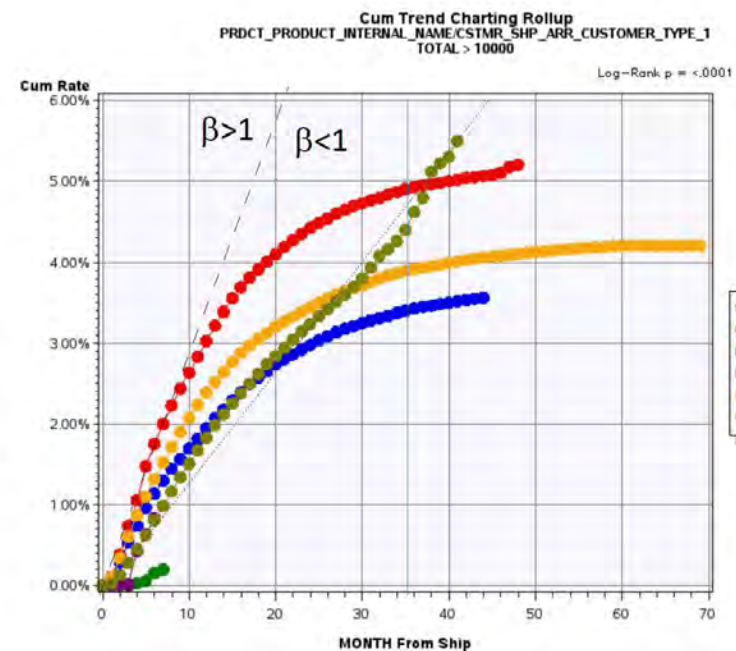
NS: 2.5" / 5400 rpm

★ - 0/5 Shows wearout ($\beta > 1$)



eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded



eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded

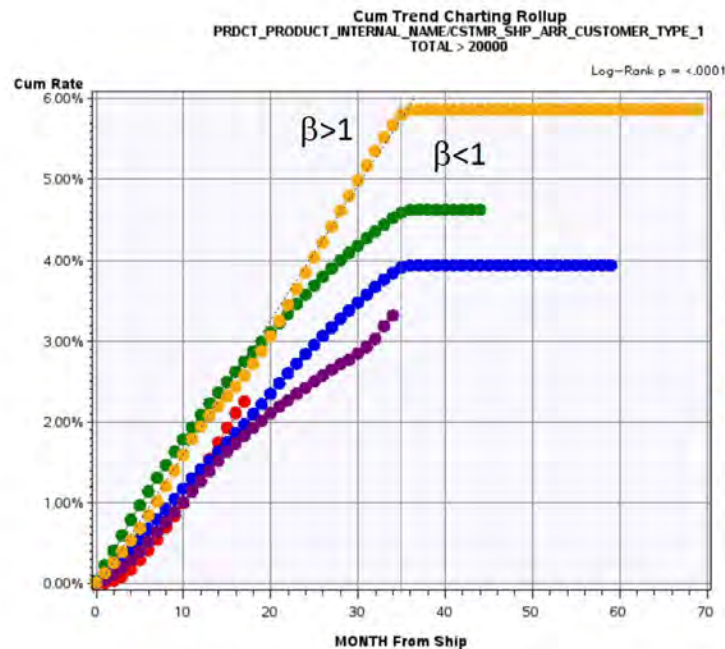
Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	5/5	3/4*
Constant ($\beta = 1$) or increasing ($\beta > 1$)	0/5	1/4

* Takes almost 2 years for the failure rate to decline

*Wyatt does not qualify

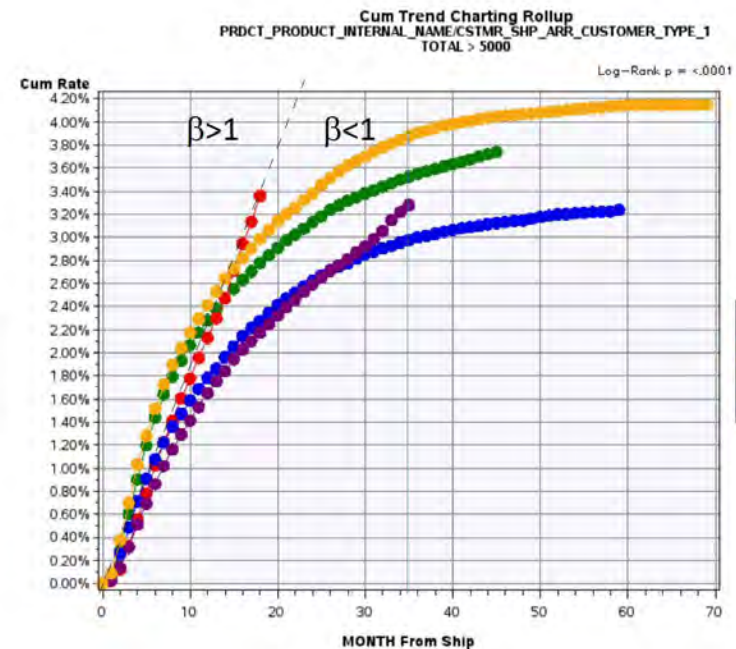
NS: 2.5" / 7200 rpm

★ - 0/5 Shows wearout ($\beta > 1$)



eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded



eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded

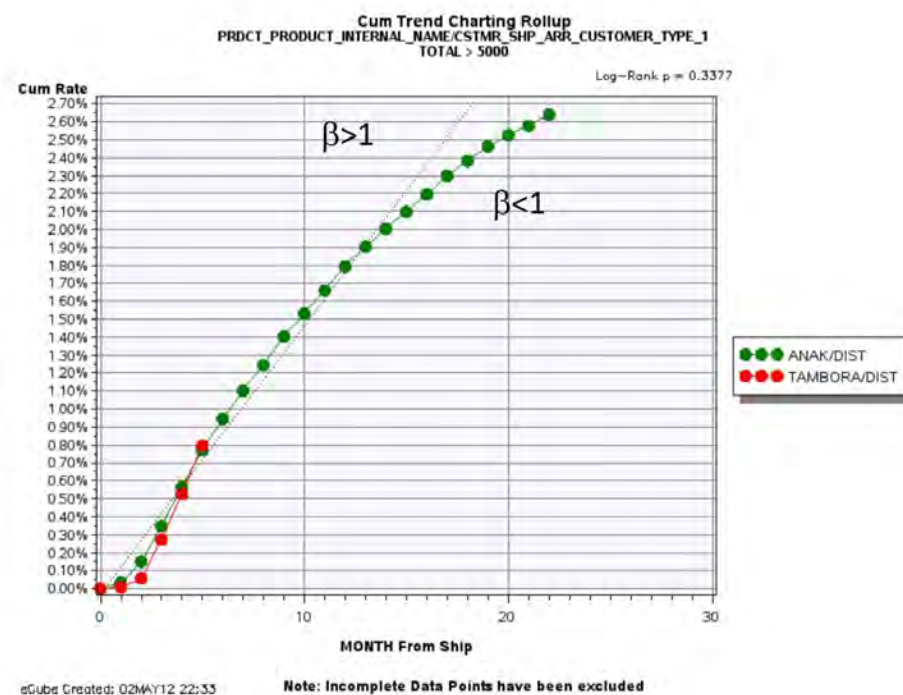
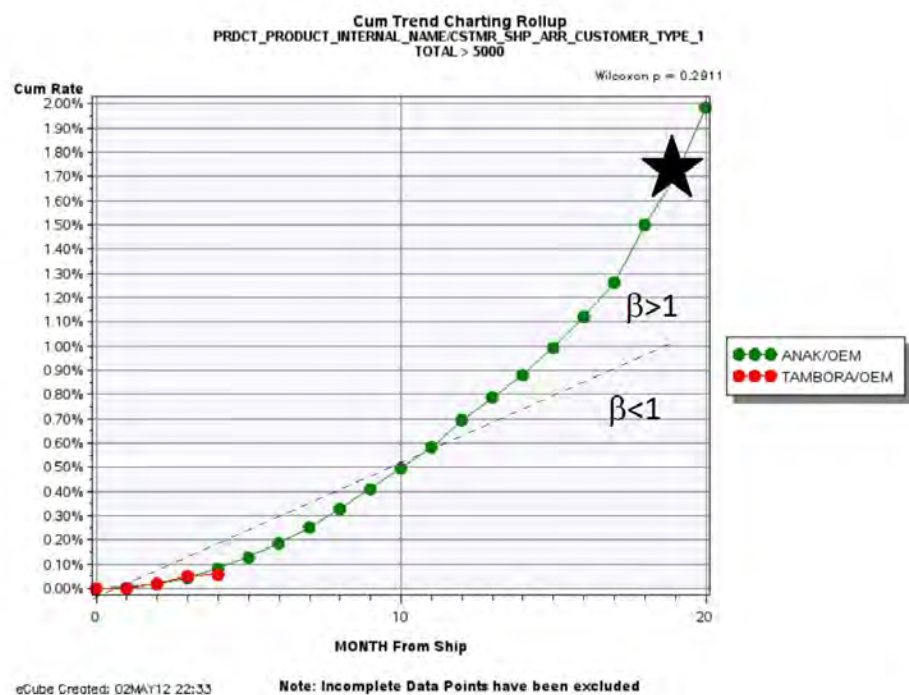
Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	1/5*	4/5*
Constant ($\beta = 1$) or increasing ($\beta > 1$)	4/5	1/4

* Casey qualifies but barely

*Desary does not qualify

NS: 2.5" (hybrid)

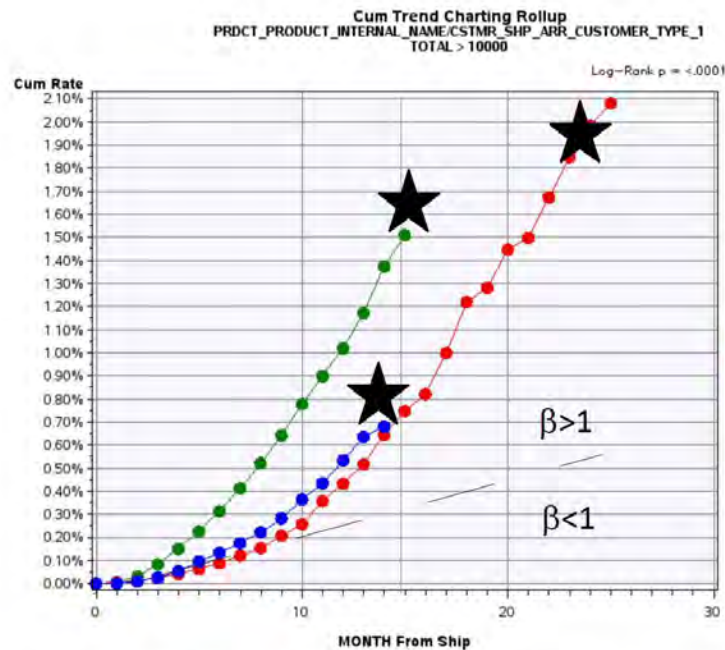
★ - 1/1 Shows wearout ($\beta > 1$)



Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	0/1	1/1
Constant ($\beta = 1$) or increasing ($\beta > 1$)	1/1	0/1

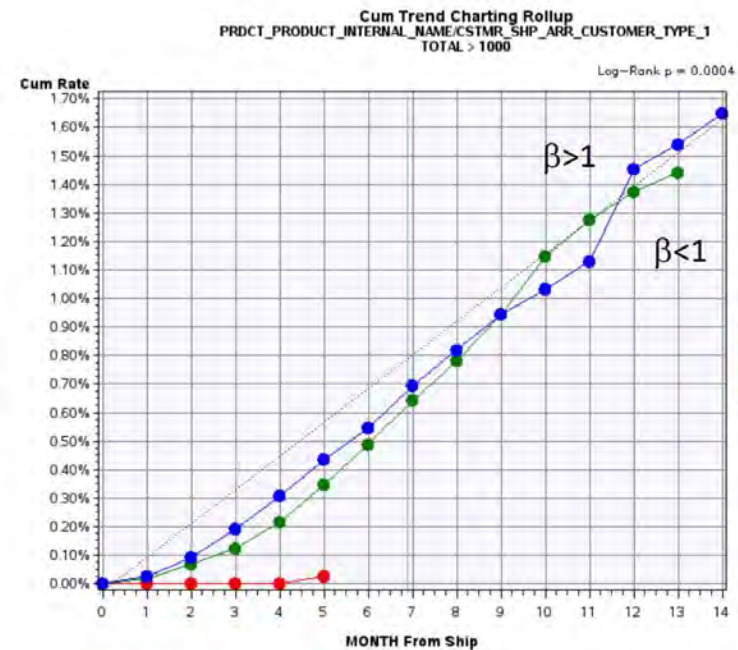
NS: 2.5" (Thin)

★ - 3/3 Shows wearout ($\beta > 1$)



eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded



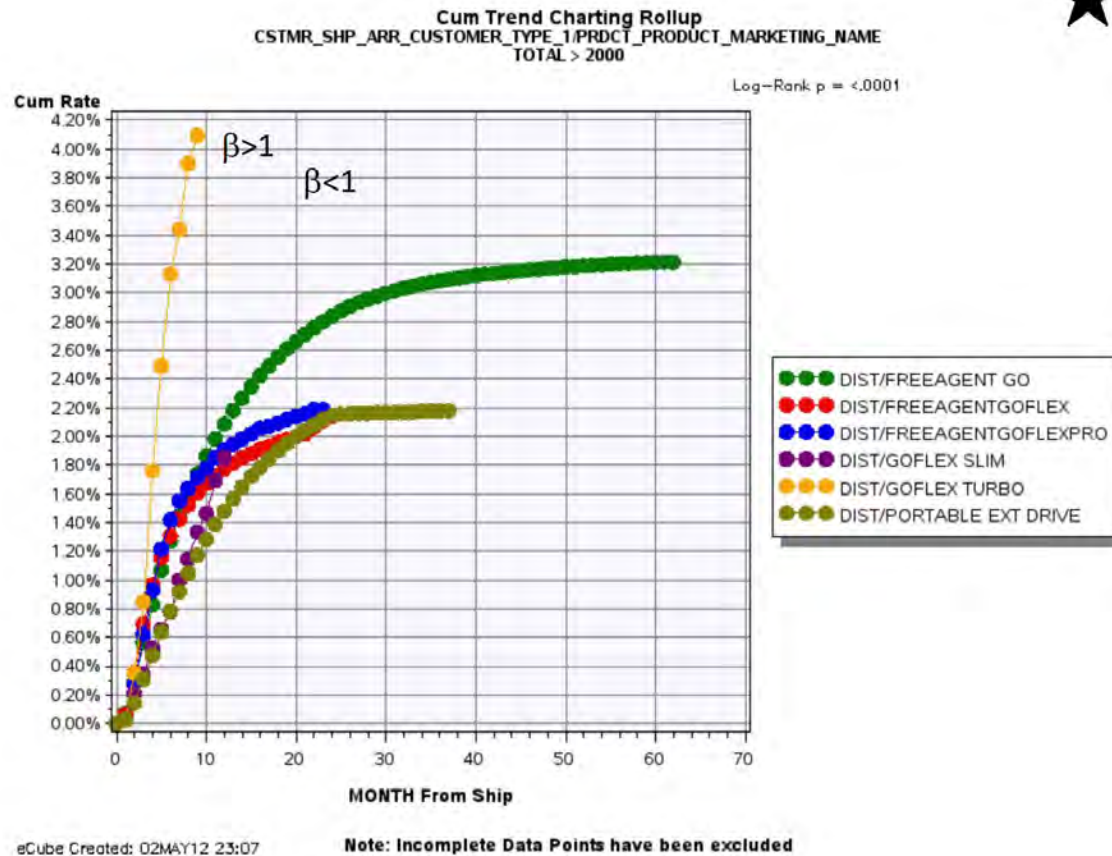
eCube Created: 02MAY12 22:33

Note: Incomplete Data Points have been excluded

Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	0/3	0/2
Constant ($\beta = 1$) or increasing ($\beta > 1$)	3/3	2/2

Retails – Portable USB

★ - 0/5 Shows wearout ($\beta > 1$)

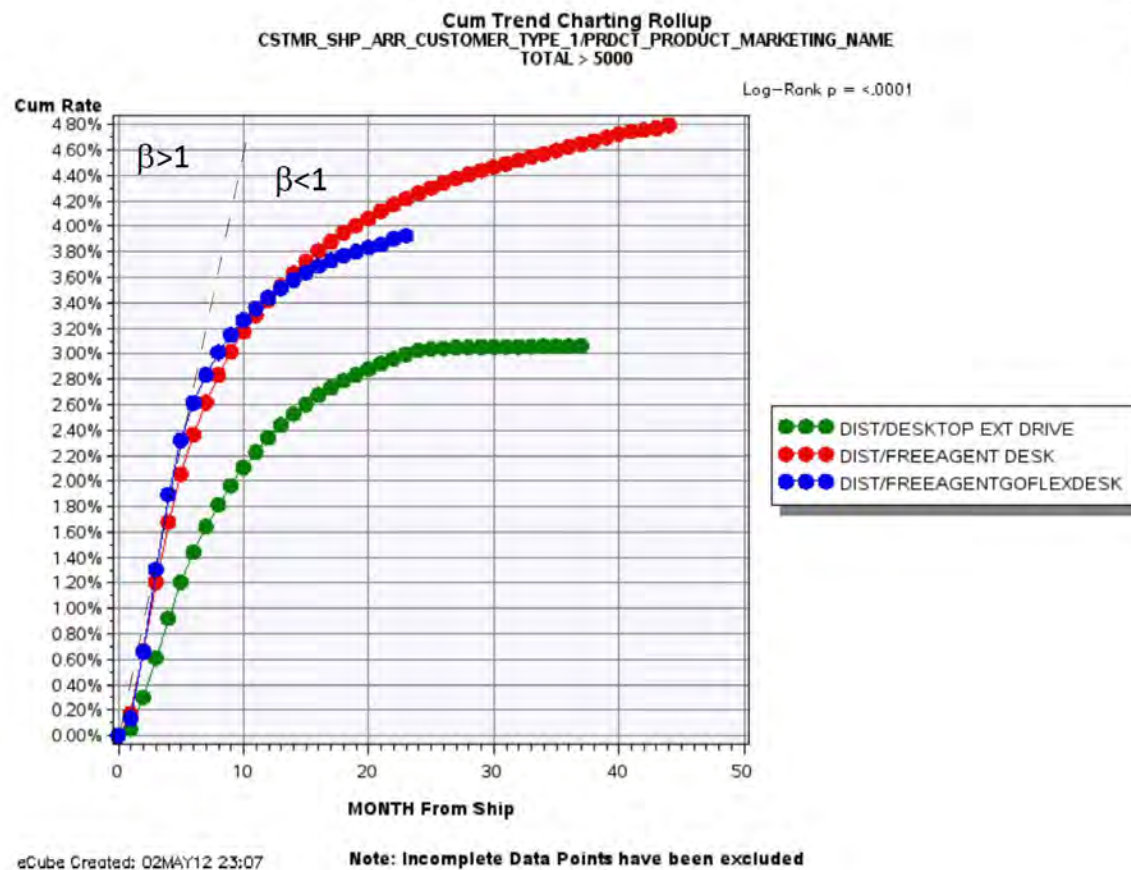


Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	n/a	4/5*
Constant ($\beta = 1$) or increasing ($\beta > 1$)	n/a	1/5

* GoFlex Slim is disqualified

Retails – Desktop USB

★ - 0/3 Shows wearout ($\beta > 1$)

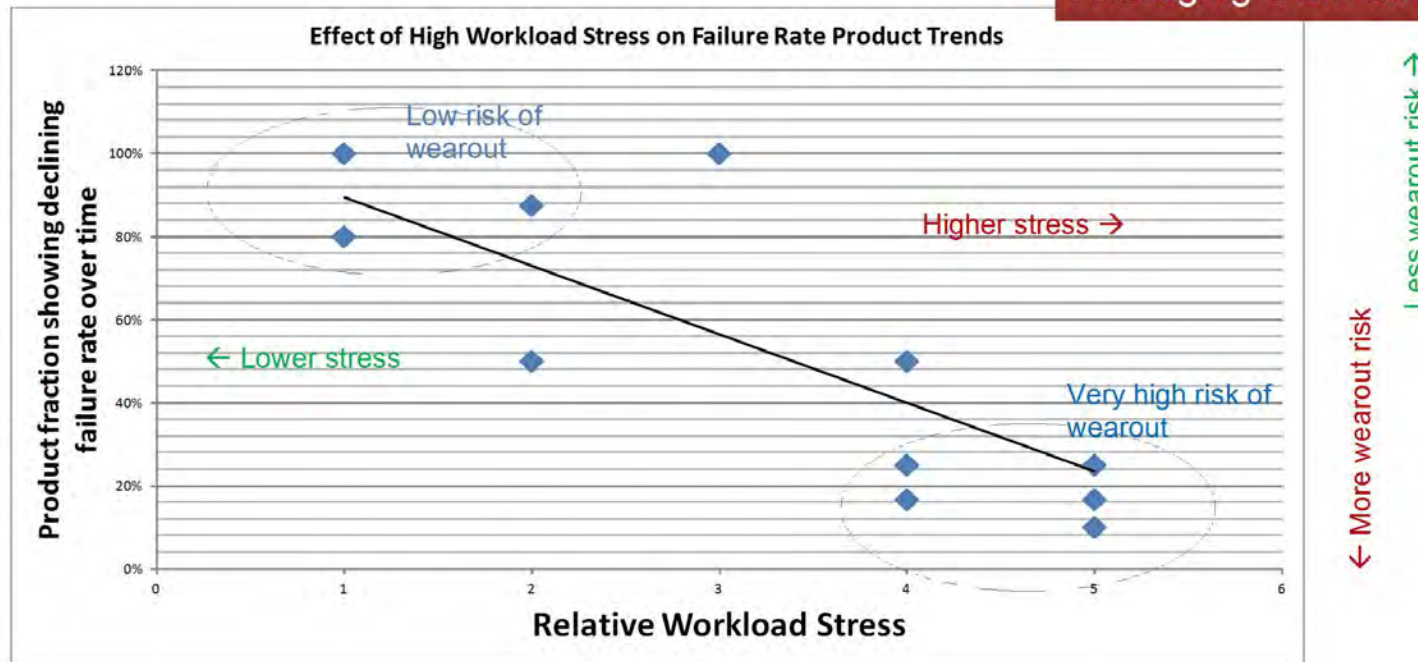


Failure rate over time	OEM Products	Distribution Products
Declining ($\beta < 1$)	n/a	3/3
Constant ($\beta = 1$) or increasing ($\beta > 1$)	n/a	0/3

Backup

Workload Stress Dependence

Averaging OEM and DISI for EC



- According to the above chart, higher workload stress could be used as an explanation to the fact that some product families show constant or increasing failure rate over time (signatures of potential wearout)
 - Less than 50% of “high workload products” (stress level 4 and 5) show failure rate improvements over life
 - At the same time, 80%+ of “low stress products” show failure rate improvements over life

FED_SEAG0001851**Metadata**

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Confidentiality	Confidential	USER
Custodian	Khurshudov_Andrei	ORIGINAL
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DATELASTMOD	6/17/2012	ORIGINAL
DOEXT	ppt	ORIGINAL
DOCTYPE	MS PowerPoint Slides (OLE)	ORIGINAL
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FED_ENDATTACH	FED_SEAG0001881	ORIGINAL
FileName	Return trends analysis and product wearout.ppt	ORIGINAL
FILESIZE	2865664	ORIGINAL
MD5 Hash	C5B2FE60528BF0E55309750DFDD5B8A3	ORIGINAL
OrgFolder	Khurshudov_Andrei\Andrei_Khurshudov-3\Andrei_Khurshudov_andrei.khurshudov@seagate.com_2.mbox\Khurshudov_Andrei\Andrei_Khurshudov-3\	ORIGINAL
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RecordType	IMAGE ATTACHMENT	ORIGINAL
Relativity Image Count	31	ORIGINAL
Relativity Native Time Zone Offset	-8.00	ORIGINAL
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TITLE	Cum Return Rates	ORIGINAL

EXHIBIT 53

No image available for this record.

FED_SEAG0090915**Metadata**

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Custodian Other	Wiley_Shenedra	ORIGINAL
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DATELASTMOD	9/1/2016	ORIGINAL
DOEXT	xlsx	ORIGINAL
DOCTYPE	MS Excel 2007-2010 Spreadsheet (Open XM	ORIGINAL
FED_BEGATTACH	FED_SEAG0090915	ORIGINAL
FED_ENDATTACH	FED_SEAG0090915	ORIGINAL
FileName	AMER CSAT May 2016_1soDRWmffEbUAJ6qLfSc5ljECfSKKYyjSCVE8EEZPGRM.xlsx	ORIGINAL
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ACCOUNT	AGENT_FUNCTION	CASE	Case Number	CONTACT_COUNTRY	CONTACT_NAME	FY	ID	INTERNAL_PRODUCT_NAME	LANGUAGE	LEAD_NAME	MANAGER_NAME	MODEL_NUMBER	Number of Records	ORIGIN	Comments	Tag	STATUS	SUB_PRODUCT_1_C
0013A000 01PEW9E QAX	TS	5003A000 00bBInoQ AO	5616002	UNITED STATES	Wendy Coleman	2016	aln3A00000 0L0WPSA0	UDONPM	English (U.S.)	Sarah Pope	Jeff Wilhelm	STDS100 0101	1	Phone	Nothing. Your product failed after I used it once, if it even backed up once effectively. Apple Care could not help us to have the Mac recognize your product. I spent 4 hours on a day off trying to resolve this issue, and no one can replace that time for me, and your policy is not to return my money. I now have a different product that continues to work reliably. When I looked online, there were multiple concerns about the reliability about the Seagate backup drive, and I just don't have faith in your product anymore. My daughter has one that so far seems to be working ok, but I am thinking about replacing that as well, with the device we have now.	Support Policy Warranty Policy	Contractor	SEAGATEBACKU PPLUSMAC

EXHIBIT 54

No image available for this record.

FED_SEAG0090943**Metadata**

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Custodian Other	Britton_Markita	ORIGINAL
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LastAccessDate	10/11/2016 12:00 AM	ORIGINAL
LastAccessedTime	2:17 AM	ORIGINAL
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Case Number	FM	MANAGER	Q1	Q2	Customer view	Management view	Q4	Comments	Management Comment	Product	Agent
4828248	5/1/2015	Markita Britton	Yes	10	Phone Experience (Wait Time/Transfers)		5	Support is fine. It is the reliability of the drives and the lack of published failure rates that is the problem. In an ideal world the drives would have a predictable failure interval so that a planned replacement or better a warning that the drive is about to fail		SEAGAT EBACKU PPLUSD	Bruce Kasden

EXHIBIT 55

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1 SHEPPARD, MULLIN, RICHTER & HAMPTON LLP
 A Limited Liability Partnership
 2 Including Professional Corporations
 NEIL A.F. POPOVIC, Cal. Bar No. 132403
 3 ANNA S. McLEAN, Cal. Bar No. 142233
 TENAYA RODEWALD, Cal. Bar No. 248563
 4 MUKUND H. SHARMA, Cal. Bar No. 249125
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 7 Facsimile: 415.434.3947
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 8 amclean@sheppardmullin.com
 trodewald@sheppardmullin.com
 9 msharma@sheppardmullin.com
 lpayne@sheppardmullin.com
 10 jsiu@sheppardmullin.com

11 Attorneys for Defendant,
 SEAGATE TECHNOLOGY, LLC
 12

13 UNITED STATES DISTRICT COURT
 14 NORTHERN DISTRICT OF CALIFORNIA
 15 SAN FRANCISCO DIVISION
 16

17 IN RE SEAGATE TECHNOLOGY, LLC
 18 LITIGATION

Case No. 3:16-cv-00523 JCS

19 CONSOLIDATED ACTION
 20

**DEFENDANT SEAGATE TECHNOLOGY
 LLC'S SUPPLEMENTAL RESPONSES
 TO PLAINTIFF CHRISTOPHER
 NELSON'S FIRST SET OF
 INTERROGATORIES**

22 PROPOUNDING PARTY: PLAINTIFF CHRISTOPHER NELSON
 23 RESPONDING PARTY: SEAGATE TECHNOLOGY, LLC
 24 SET NO.: ONE
 25

HIGHLY CONFIDENTIAL

1 Defendant Seagate Technology LLC (“Seagate”) hereby supplements its responses
2 to Interrogatories Number 1, 2, and 8 in the First Set of Interrogatories propounded by plaintiff
3 Christopher Nelson (“Plaintiff”).

4 **GENERAL STATEMENT AND OBJECTIONS**

5 **GENERAL OBJECTIONS**

6 1. The following responses are made solely for purposes of this action. Each response
7 is subject to all objections as to competence, relevance, materiality, propriety and admissibility,
8 and any and all other objections and grounds which would require the exclusion of any statements
9 contained herein, if such statements were made by a witness present and testifying at court, all of
10 which objections and grounds are reserved and may be interposed at the time of trial.

11 2. The following responses are based upon information presently available to Seagate.
12 Seagate is not making any incidental or implied admissions regarding the contents of these
13 responses. Seagate’s objections, and any subsequent responses, are at all times subject to such
14 additional or different information as may result from further discovery, investigation, and/or
15 refreshing of recollection. Seagate reserves the right to alter, amend, or supplement any responses
16 it makes to Plaintiff’s First Set of Interrogatories. Seagate reserves the right to make any use of,
17 or to introduce at any hearing and at trial, information responsive to the First Set of
18 Interrogatories, but discovered subsequent to the date of any responses to the First Set of
19 Interrogatories, including, but not limited to, any such information obtained in discovery herein.
20 The fact that Seagate has answered part or all of any Interrogatory is not intended to and shall not
21 be construed to be a waiver by Seagate of all or any part of any objections to any Interrogatory.

22 3. Seagate objects to the Interrogatories to the extent they seek information outside
23 the possession, custody, or control of Seagate and that is not within Seagate’s personal knowledge.
24
25
26
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OBJECTIONS TO DEFINITIONS

1
2 1. Seagate objects to the definition of SEAGATE or YOU as overbroad to the extent
3 Plaintiffs purport to ask for privileged information from Seagate attorneys.

RESPONSES TO INTERROGATORIES**INTERROGATORY NO. 1:**

6 State the total annual unit sales, by year and by state, of Hard Drives sold within
7 the United States.

SUPPLEMENTAL RESPONSE TO INTERROGATORY NO. 1:

9 Seagate incorporates the General Objections set forth above to the extent
10 applicable. Seagate objects to this interrogatory because it is premature and seeks information
11 irrelevant to class certification or liability. Seagate further objects to this interrogatory because it
12 seeks sensitive commercial and business information protected by California law. Subject to and
13 without waiving the foregoing objections, Seagate responds as follows:

14 Pursuant to the Parties' meet and confer agreement, Seagate agreed to, and did,
15 provide data responsive to this interrogatory for each of the Drives identified in the Second
16 Consolidated Amended Complaint ("SCAC") by year pursuant to state and federal mediation
17 privileges. *Cf.* Fed. R. Evid. 501 ("[I]n a civil case, state law governs privilege regarding a claim
18 or defense for which state law supplies the rule of decision."); Cal. Evid. Code §§ 1115 *et seq.*; *see*
19 *also* Fed. R. Evid. 408 (protecting conduct and communications made for purposes of offers of
20 compromise or negotiations).

21 In Table 1 below, Seagate provides total annual net unit sales in the U.S. of
22 products containing drive model number ST3000DM001. Sales data from September 2011
23 through December 2011 are subject to change, and Seagate is working to confirm these data.
24 Seagate does not track sales of consumer products to consumers on a state-by-state basis.

INTERROGATORY NO. 2:

26 State the total annual revenue, by year and by state, from sales of Hard Drives
27 within the United States.

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SUPPLEMENTAL RESPONSE TO INTERROGATORY NO. 2:

Seagate incorporates the General Objections set forth above to the extent applicable. Seagate objects to this interrogatory because it is premature and seeks information irrelevant to class certification or liability. Seagate further objects to this interrogatory because it seeks sensitive commercial and business information protected by California law. Subject to and without waiving the foregoing objections, Seagate responds as follows:

Pursuant to the Parties' meet and confer agreement, Seagate agreed to, and did, provide data responsive to this interrogatory for each of the Drives identified in the SCAC by year pursuant to the mediation privilege. *Cf.* Fed. R. Evid. 501 ("[I]n a civil case, state law governs privilege regarding a claim or defense for which state law supplies the rule of decision."); Cal. Evid. Code §§ 1115 *et seq.*; *see also* Fed. R. Evid. 408 (protecting conduct and communications made for purposes of offers of compromise or negotiations).

In Table 2 below, Seagate provides the total annual net revenues in the U.S. of drives containing drive model number ST3000DM001. Sales data from September 2011 through December 2011 are subject to change, and Seagate is working to confirm these data. Seagate does not track sales of consumer products to consumers on a state-by-state basis.

INTERROGATORY NO. 8:

State the total annual revenue, by year and by state, from any recovery services paid to You by consumers for Hard Drives sold in the United States.

SUPPLEMENTAL RESPONSE TO INTERROGATORY NO. 8:

Seagate incorporates the General Objections set forth above to the extent applicable. Seagate objects to this interrogatory to the extent that it seeks sensitive commercial and business information protected by California law. Seagate further objects to this interrogatory on grounds that it seeks information related to consequential damages, which are not recoverable, and thus not relevant to Plaintiff's claims or defenses. As such, the interrogatory falls outside the permissible scope of discovery. Seagate further objects to this interrogatory to the extent it seeks confidential consumer information protected by the California Constitution. Subject to and without waiving the foregoing objections, Seagate responds as follows:

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1 Pursuant to the Parties' meet and confer agreement, Seagate agreed to, and did,
2 provide data responsive to this interrogatory for each of the Drives identified in the SCAC by year
3 pursuant to state and federal mediation privileges. *Cf.* Fed. R. Evid. 501 ("[I]n a civil case, state
4 law governs privilege regarding a claim or defense for which state law supplies the rule of
5 decision."); Cal. Evid. Code §§ 1115 *et seq.*; *see also* Fed. R. Evid. 408 (protecting conduct and
6 communications made for purposes of offers of compromise or negotiations).

7 Seagate further responds that its customers have paid approximately \$674,225 for
8 data recovery charges through May 2017, with filters applied to eliminate obvious institutional
9 customers (businesses, non-profits, government entities, educational institutions) and non-US
10 customers.

11 Dated: August 18, 2017

12 SHEPPARD, MULLIN, RICHTER & HAMPTON LLP

13
14 By

/s/ Anna S. McLean

NEIL A.F. POPOVIC

ANNA S. McLEAN

MUKUND H. SHARMA

TENAYA RODEWALD

LIÊN H. PAYNE

JOY O. SIU

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16
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19 Attorneys for Defendant
20 SEAGATE TECHNOLOGY, LLC
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HIGHLY CONFIDENTIAL

Table 1: U.S. Net Unit Sales of Drives Containing Drive Model Number ST3000DMM001

Year	Business 1 Bay NAS	Business 2 Bay NAS	Business 4 Bay NAS	D3 Station	Desktop Ext. Drive	Barracuda – Desktop Internal HDD Kit.	FreeAgent GoFlex Desk	FreeAgent GoFlex Home	GoFlex Desk For Mac	Backup Plus Desk	Backup Plus Mac	Seagate Expansion Desk	Seagate Expansion Desk Plus
2011	0	0	0	0	34,651	11371	100,046	14,663	1,071	0	0	0	0
2012	0	0	0	0	29,389	52093	161,691	41,196	3,610	304,921	6,527	62,959	0
2013	843	1,074	956	15,917	-61	47499	-2,138	-1,563	1,377	377,644	11,130	138,542	12,657
2014	1,017	590	441	29,913	0	46234	-507	-112	-8	171,329	15,607	94,609	30,023
2015	110	21	39	20,683	0	56541	-6	-2	0	67,714	14,452	133,036	28,106
2016	0	0	-7	2,383	0	34067	-1	0	0	49,092	11,942	28,135	8,162
2017*	0	0	0	-2	0	6760	0	0	0	17,194	-55	19,698	-17
Total	1,970	1,685	1,429	68,894	63,979	254,565	259,085	54,182	6,050	987,894	59,603	476,979	78,931

* Data for 2017 is through May 2017.

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Table 2: U.S. Net Revenues of Drives Containing Drive Model Number ST3000DM001

Year	Business 1 Bay NAS	Business 2 Bay NAS	Business 4 Bay NAS	D3 Station	Desktop Ext. Drive	Barracuda – Desktop Internal HDD Kit.	FreeAgent GoFlex Desk	FreeAgent GoFlex Home	GoFlex Desk For Mac	Backup Plus Desk	Backup Plus Mac	Seagate Expansion Desk	Seagate Expansion Desk Plus
2011	\$0	\$0	\$0	\$0	\$5,048,232	\$2,103,833	\$16,034,150	\$2,588,140	\$173,308	\$0	\$0	\$0	\$0
2012	\$0	\$0	\$0	\$0	\$3,619,747	\$7,983,201	\$21,868,334	\$6,404,085	\$909,077	\$38,697,219	\$982,128	\$7,494,081	\$0
2013	\$156,200	\$432,325	\$770,780	\$1,840,595	-\$6,824	\$6,040,590	-\$179,563	-\$231,704	\$121,539	\$42,714,613	\$1,473,181	\$14,753,524	\$1,265,700
2014	\$190,618	\$224,318	\$333,594	\$3,134,456	\$0	\$5,136,694	-\$35,039	-\$21,381	-\$3,922	\$18,697,510	\$1,715,618	\$9,671,078	\$2,981,410
2015	\$21,189	\$8,568	\$29,978	\$2,176,874	\$0	\$5,664,510	-\$213	-\$153	\$0	\$7,416,248	\$1,592,631	\$13,856,740	\$2,667,158
2016	\$0	\$0	-\$4,380	\$226,365	\$0	\$2,975,799	-\$111	\$0	\$0	\$4,061,881	\$1,112,226	\$2,401,176	\$615,443
2017*	\$0	\$0	\$0	-\$190	\$0	\$577,560	\$0	\$0	\$0	\$1,295,199	-\$5,143	\$1,570,729	-\$1,273
Total	\$368,006	\$665,211	\$1,129,971	\$7,378,100	\$8,661,155	\$30,482,188	\$37,687,659	\$8,738,987	\$1,200,003	\$112,882,671	\$6,870,641	\$49,747,327	\$7,528,438

* Data for 2017 is through May 2017.

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VERIFICATION

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

I have read the foregoing DEFENDANT SEAGATE TECHNOLOGY, LLC'S
SUPPLEMENTAL RESPONSES TO PLAINTIFFS' FIRST SET OF INTERROGATORIES and
know its contents.

I am the Director of Supply Chain of Seagate Technology, LLC, a party
to this action, and am authorized to make this verification for and on its behalf, and I make this
verification for that reason. I am informed and believe and on that ground allege that the matters
stated in the foregoing document are true.

I declare under penalty of perjury under the laws of the State of California that the
foregoing is true and correct.

Executed on August 10, 2017, at Cupertino, California.

Scott Robbeleth
Print Name of Signatory


Signature

PROOF OF SERVICE
In re Seagate Technology LLC Litigation
USDC Case No. 5:16-cv-00523-JCS

I am over eighteen years old, not a party to the within action, and made the following service from my place of employment—Sheppard, Mullin, Richter & Hampton, 379 Lytton Ave., Palo Alto, CA 94301. On August 18, 2017, I served the following document:

DEFENDANT SEAGATE TECHNOLOGY, LLC'S SUPPLEMENTAL
RESPONSES TO PLAINTIFF'S FIRST SET OF INTERROGATORIES

in pdf format from my email address (msharma@sheppardmullin.com) to the persons at the email addresses listed below:

- **Steve W. Berman**
steve@hbsslaw.com; heatherw@hbsslaw.com; nicolleg@hbsslaw.com; josephs@hbsslaw.com;
- **Jeff D Friedman**
jefff@hbsslaw.com; jeanethd@hbsslaw.com; sf_filings@hbsslaw.com; nicolleg@hbsslaw.com
- **Shana E. Scarlett**
shanas@hbsslaw.com
- **Bryan L. Clobes**
bclobes@caffertyclobes.com
- **Marc Adam Goldich**
mgoldich@axgolaw.com; mstrout@axgolaw.com
- **Ashley A. Bede**
AshleyB@hbsslaw.com
- **Noah Axler**
naxler@axgolaw.com
- **Nyran Rose Rasche**
nrasche@caffertyclobes.com, docket@caffertyclobes.com, snyland@caffertyclobes.com

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct and that I am employed in the office of a member of the bar of this Court at whose direction the service was made.

Executed on August 18, 2017, at Palo Alto, California.

/s/ Mukund H. Sharma
Mukund H. Sharma

EXHIBIT 56

1 UNITED STATES DISTRICT COURT
2 NORTHERN DISTRICT OF CALIFORNIA
3 SAN JOSE DIVISION
4

5 IN RE SEAGATE TECHNOLOGY LLC,)
6 LITIGATION)
7) NO. 5:16-cv-00523-RMW
8)
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25)

DEPOSITION OF JEFFREY FOCHTMAN

Palo Alto, California

Friday, August 18, 2017

Reported By:

LINDA VACCAREZZA, RPR, CLR, CRP, CSR. NO. 10201

JOB NO. 210527

1 are the primary audience. I think the primary
2 audience is our reselling partner base.

3 Q. So an end user or an end consumer could go
4 out and find the storage solution guide on the
5 Internet, for example, but they were not what you
6 had mind when you created the guide?

7 A. That's the way I look at it.

8 Q. What's the global marketing team's
9 involvement in creating these storage solution
10 guides?

11 A. We create them. So global marketing is in
12 charge of assembling and compiling that information
13 and putting it into a creative format.

14 Q. And are there different storage solution
15 guides by region?

16 A. There have been. We have changed
17 practices on how we have done that over time.

18 MS. BEDE: Can you grab the documents
19 behind Tab 5, please, and mark that as Exhibit 3.

20 (Exhibit 3 was marked for identification.)

21 THE WITNESS: All right.

22 BY MS. BEDE:

23 Q. Okay. What is this?

24 A. This is a storage, Seagate Storage
25 Solutions Guide from May 2012, with the region

1 being listed as Americas, and it says "AMER," which
2 is our abbreviation for Americas.

3 Q. When did you stop creating storage
4 solution guides by region?

5 MR. POPOVIC: Objection. Lack of
6 foundation.

7 THE WITNESS: It varied over time.

8 BY MS. BEDE:

9 Q. Okay. If you can turn to just the second
10 page there. Actually, it's the third page. It
11 shows sort of the external products that are
12 covered in this storage solution guide; is that
13 right?

14 A. Yes.

15 Q. And it includes the Backup Plus, the
16 Backup Plus for Mac, and the Backup Plus Desk. Do
17 you see those ones?

18 A. I do.

19 Q. Okay. As well as it also covers other
20 external storage products, right?

21 A. Correct.

22 Q. So on the following page, do you see where
23 it says "External storage solutions"?

24 A. Yes.

25 Q. And there's a phrase underneath there that

EXHIBIT 61

STATE OF MINNESOTA)
)
COUNTY OF HENNEPIN) SS.

DECLARATION OF DEREK NOER

I, Derek Noer, declare as follows:

1. I am over 18 years of age.
2. I make this Declaration based on my personal knowledge on behalf of Best Buy Co., Inc. ("Best Buy"), 7601 Penn Avenue South, Richfield, Minnesota 55423. If called upon as a witness, I could and would competently testify to the matters stated herein.
3. I am an employee of Best Buy Enterprise Services, Inc., a subsidiary of Best Buy. My title is Associate Director for Information and Records Management.
4. I have reviewed the Subpoena served on Best Buy by Plaintiffs for the matter In re Seagate Technology LLC Litigation, Civil Action No. 3:16-cv-00523-JCS, filed in the United States District Court for the Northern District of California.
5. Best Buy has been advised by Plaintiff's counsel that the proposed class contained in the Plaintiffs' Motion for Class Certification is as follows:

All individuals in the United States who purchased new, not for resale, on or before February 1, 2016, at least one Seagate model ST3000DM001 hard drive or at least one drive with any of the following model numbers on the box it was sold in or on the hard drive's casing or chassis: STAC3000100, STAC3000102, STAC3000202, STAC3000402, STAC3000403, STAC3000404, STAC3000602, STAM3000100, STAM3000400, STAY3000100, STAY3000102, STBC3000101, STBC3000102, STBD3000100, STBM3000100, STBN6000100, STBP12000100, STBV3000100, STBV3000200, STCA3000101, STCA3000600, STCA3000601, STCA3000602, STCB3000100, STCB3000101, STCB3000201, STCB3000400, STCB3000401, STCB3000900, STCB3000901, STCP3000100, STCP3000400, STDT3000100, STDT3000400, STDT3000402, STDT3000600, STDU3000101, STDU3000400,

STEB3000100, STEB3000200, STEB3000400, STEG3000100, STEG3000400, STFM3000100, or STFM3000400.

6. Best Buy has been advised by Plaintiff's counsel that the Plaintiffs have also proposed the following state classes in the alternative:

All individuals in the jurisdictions of California, Florida, Massachusetts, New York, South Carolina, South Dakota, Tennessee, and Texas, who purchased, not for resale, on or before February 1, 2016, at least one Seagate model ST3000DM001 hard drive or at least one drive with any of the following model numbers on the box it was sold in or on the hard drive's casing or chassis: STAC3000100, STAC3000102, STAC3000202, STAC3000402, STAC3000403, STAC3000404, STAC3000602, STAM3000100, STAM3000400, STAY3000100, STAY3000102, STBC3000101, STBC3000102, STBD3000100, STBM3000100, STBN6000100, STBP12000100, STBV3000100, STBV3000200, STCA3000101, STCA3000600, STCA3000601, STCA3000602, STCB3000100, STCB3000101, STCB3000201, STCB3000400, STCB3000401, STCB3000900, STCB3000901, STCP3000100, STCP3000400, STDT3000100, STDT3000400, STDT3000402, STDT3000600, STDU3000101, STDU3000400, STEB3000100, STEB3000200, STEB3000400, STEG3000100, STEG3000400, STFM3000100, or STFM3000400.

7. Best Buy has served objections to the Subpoena.

8. Subject to and without waiver of its objections, Best Buy has searched for information responsive to Plaintiffs' Subpoena in temporary satisfaction of compliance with it, and as a result, has produced to Plaintiffs certain responsive Point of Sale (POS) transaction data (the "POS Data Production").

9. The POS Data Production did not contain customer information related to the subject transactions.

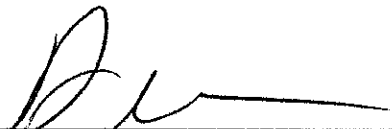
10. Customer information may be—but is not always—provided to Best Buy by Best Buy customers during an interaction between Best Buy and customer. Best Buy solely relies on customers to provide the information.

11. Customer information includes, but is not limited to, contact, billing and shipping information. When provided by the customer, these records are kept by Best Buy in the ordinary course of business at or near the time of the acts, conditions or events described above.

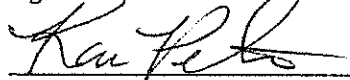
12. Subject to and without waiver of its objections, if called upon to do so, Best Buy could and would perform a search for the most current customer information that exists related to the transactions contained within the POS Data Production, which would contain customer information for at least some of the proposed class and state class members, with the caveat that not all transactions may have corresponding customer information sufficient to identify the purchaser.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: November 7, 2017 in Richfield, Minnesota.


Derek Noer

Signed and sworn to before me on this 7 day of November, 2017.


Notary Public

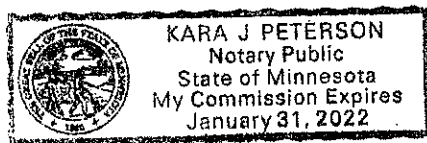


EXHIBIT 62

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

IN RE SEAGATE TECHNOLOGY LLC
LITIGATION

No. 3:16-cv-00523-JCS

DECLARATION OF OFFICE DEPOT, INC.

I, Timothy Driscoll, declare as follows:

1. I am a Director of Database Marketing and Systems at Office Depot, Inc. ("Office Depot"). I have signed this declaration on behalf of Office Depot. I have personal knowledge of the matters stated herein and, if called upon, I could competently testify thereto.

2. In a subpoena dated June 28, 2017, served on Office Depot on July 3, 2017, the Plaintiffs requested, among other things, the production of documents sufficient to identify each customer who purchased the hard drives at issue in this litigation, including full names, addresses, and email addresses.

3. Office Depot was informed that the proposed class contained in the Plaintiffs' Motion for Class Certification is as follows:

All individuals in the United States who purchased new, not for resale, on or before February 1, 2016, at least one Seagate model ST3000DM001 hard drive or at least one drive with any of the following model numbers on the box it was sold in or on the hard drive's casing or chassis STAC3000100, STAC3000102, STAC3000202, STAC3000402, STAC3000403, STAC3000404, STAC3000602, STAM3000100, STAM3000400, STAY3000100, STAY3000102, STBC3000101, STBC3000102, STBD3000100, STBM3000100, STBN6000100, STBP12000100, STBV3000100, STBV3000200, STCA3000101, STCA3000600, STCA3000601, STCA3000602, STCB3000100, STCB3000101, STCB3000201, STCB3000400, STCB3000401, STCB3000900, STCB3000901, STCP3000100, STCP3000400, STDT3000100, STDT3000400, STDT3000402, STDT3000600, STDU3000101, STDU3000400, STEB3000100, STEB3000200, STEB3000400, STEG3000100, STEG3000400, STFM3000100, or STFM3000400.

4. Office Depot was informed that the Plaintiffs have also proposed the following state classes in the alternative:

All individuals in the jurisdictions of California, Florida, Massachusetts, New York, South Carolina, South Dakota, Tennessee, and Texas, who purchased new, not for resale, on or before February 1, 2016, at least one Seagate model ST3000DM001 hard drive or at least one drive with any of the following model numbers on the box it was sold in or on the hard drive's casing or chassis: STAC3000100, STAC3000102, STAC3000202, STAC3000402, STAC3000403, STAC3000404, STAC3000602, STAM3000100, STAM3000400, STAY3000100, STAY3000102, STBC3000101, STBC3000102, STBD3000100, STBM3000100, STBN6000100, STBP12000100, STBV3000100, STBV3000200, STCA3000101, STCA3000600, STCA3000601, STCA3000602, STCB3000100, STCB3000101, STCB3000201, STCB3000400, STCB3000401, STCB3000900, STCB3000901, STCP3000100, STCP3000400, STDT3000100, STDT3000400, STDT3000402, STDT3000600, STDU3000101, STDU3000400, STEB3000100, STEB3000200, STEB3000400, STEG3000100, STEG3000400, STFM3000100, or STFM3000400.

5. Office Depot currently has purchase history for the applicable time frame running from January 1, 2011 to the present, but not every purchase will have customer contact information associated with it. Office Depot confirms that it has some information responsive to this request including some names, addresses, and/or email addresses of proposed class and subclass members and the relevant products those class members and state class members purchased.

6. Office Depot reserves its objections served in response to the subpoena, including but not limited to its objection that the retrieval of this data would be time consuming and burdensome.

7. Office Depot also reserves its objections to the production of data on privacy grounds and declines to provide this data at this time in the absence of a court order.

8. If ordered by the Court, however, upon granting of class certification in this case, Office Depot would be able to extract and produce to the indirect purchaser plaintiffs or a third-party notice administrator, the names, physical addresses and/or email addresses of some class members and the relevant products class members and subclass members purchased.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct to the best of my knowledge and belief. Executed this 9th day of November, 2017, at Boca Raton, Florida.

/s/


Timothy Driscoll

Director of Database Marketing and Systems

EXHIBIT 64

Message

From: Raymond Wong [raymondw@synnex.com]
Sent: 6/25/2012 4:29:21 PM
To: dave.rollings@seagate.com
CC: electra.stockwell@seagate.com; Sherman Ng [shermann@synnex.com]
Subject: FW: Returning of Seagate hard drives

Hi Dave!

Did you get a chance to reach out to IX to resolve the firmware issue on the ST3000DM001? This is the same situation about the customer receiving "Dell OEM" drives.

Eeeeeeeeeeeeeee, fyi, we only have TAB-500 coming into stock...

Thanks-
Ray

-----Original Message-----

From: Helen Liu
Sent: Monday, June 25, 2012 9:25 AM
To: Raymond Wong
Cc: Bret Morris
Subject: FW: Returning of Seagate hard drives

Raymond

Can you follow up with Seagate (Dave Rollings) to see if they did reach out to IX and make an attempt to resolve w/out RMA?

Thanks

-----Original Message-----

From: Chris Try [mailto:ctry@ixsystems.com]
Sent: Friday, June 22, 2012 6:56 PM
To: Helen Liu
Cc: Bret Morris; austin@ixsystems.com
Subject: Returning of Seagate hard drives

Hello Helen,

We are looking to return a large batch of Seagate hard drives part# ST3000DM001. Unfortunately we are unable to use these hard drives due to the CC4B firmware. Please let me know if there are any procedures that I should pay attention to in order to complete this process. Thank you.

-Chris

--

Christopher Try
iXsystems, Inc.
408.943.4100 x115
408.943.4101 fax
ctry@iXsystems.com
www.iXsystems.com
"Enterprise Servers for Open Source."

EXHIBIT 65

From: hdan@ups.com
Sent: Tuesday, February 07, 2012 3:46 AM
To: brijesh.ku.singh@seagate.com; asia_shiphold@seagate.com
Subject: RE: Grenada SHIP HOLD - Status: Full Release Pending Verification(--SSO # KOR-0187-00) -- ORT MTBF trigger.

请提示, FGI 是否需要相关操作, 谢谢。

Brgds,

He Dan

He Dan

Operator Assistant, Distribution dept

UPS SCS (China) Limited Wuxi Branch

Lot 111, XingChuang Road 3, Wuxi Singapore Industrial Park 214028 Wuxi China

PHONE: 86-510-85281981 Ext: 103

FAX: 86-510-85281979

E-Mail: hdan@ups.com

Web Site: [Http://www.ups.com](http://www.ups.com)

From: Brijesh.KU.Singh@seagate.com [mailto:Brijesh.KU.Singh@seagate.com]
Sent: Tuesday, February 07, 2012 4:08 PM
To: Asia_Shiphold@seagate.com
Cc: brijesh.ku.singh@seagate.com
Subject: Fw: Grenada SHIP HOLD - Status: Full Release Pending Verification(--SSO # KOR-0187-00) -- ORT MTBF trigger.

----- Forwarded by Brijesh KU Singh/Seagate on 02/07/2012 02:45 PM -----



Double Click Here to Access the Live Document!.

Title:	ORT MTBF trigger.		
ShipHold Site:	KOR-Thailand	Status:	Full Release Pending Verification
Product Model #:	ST3000DM001, ST2000DM001, ST1000DM003	SH#:	KO SH-00312-01
		Ref SSO#:	KOR-0187-00
Part Number:	9YNxxx-xxx , 9YWxxx-xxx		
Date Created:	02/04/2012	Market Segment:	PSG
		VIQ:	

Revision History**Ver Date Author Description of Change**

00 12-Feb-04 10:00 PM Brijesh KU Singh/Seagate Initial Release
 01 12-Feb-05 10:34 AM Sarun Nantavisuth/Seagate Add affected Qty info.

General

Ship Hold Approval

Ship Hold has been Approved by:	Brijesh KU Singh	Date Approved:	02/04/2012
Approver Comments:	No Comment		

Reason

Grenada ORT MTBF is currently at 90K MTBF against spec of 250K. 2 months back RDT demonstration was at 250K MTBF. Over last 4 weeks failures are 2X. **Based on current MTBF performance SSO is placed for drive build from all 3 site (Krt , SZ and Wx).**

The SSO is for client shipments only at following configs post DOM 25

- A. 2H 1T
- B. 4H 2T
- C. 6H 3T

No sso for any SBS configs or CTU shipments.

Affected quantity

ORT SSO# 0187	WIP	FGI	Shipped	Total	Remark
Korat	46558	25063	320025	391646	
Wuxi	Under data crunch	81625	Under data crunch	81625	2TB under identify for affected from 12400 drive.
SuZhou	Under data crunch	231590	Under data crunch	231590	2TB under identify for affected from 37400 drive.
Total	46558	338278	320025	704861	

▽ Affected detail by P/N
 Affected detail by P/N

China Affected. (FGI)

Site	P/N	Qty	
Wuxi	9YN162-302	14175	
	9YN162-303	900	
	9YN162-500	2950	
	9YN164-302	12400	mix of 4H/5H
	9YN166-302	61100	
	9YN166-500	2400	
	9YN16G-302	100	
	Grand Total	94025	
Suzhou	9YN162-302	35225	
	9YN162-303	26450	
	9YN162-500	7975	
	9YN164-302	37400	mix of 4H/5H
	9YN164-500	11740	
	9YN166-302	140280	
	9YN166-500	9880	
	9YN16G-302	40	
	Grand Total	268990	

Korat Affected. (FGI)

Count of SERIAL_NUM	Affected	
PART_NUM	Yes	Grand Total
9YN162-033	165	165
9YN162-302	5050	5050
9YN162-303	2800	2800
9YN162-500	2150	2150
9YN164-302	4769	4769
9YN164-500	895	895
9YN166-033	240	240
9YN166-302	8854	8854
9YN166-500	140	140
Grand Total	25063	25063

ORT SSO W32	WIP	FGI	Shipped	Total
Korat Affected	46558	25063	320025	391646

(See attached file: Shipped_SN.zip)

Conditional Release
Conditional Release

ORT Fix Effectiveness

Failure Mode	FE%	Comments / Requirements
Degraded / Unstable Heads	68%	7 of 9 failures caught with Upstream + Cert specs. Spec criteria must be permanently made in a PCO and/or upstream spec
1D Alphana	100%	1D / Alphana restriction to SBS
NMD	0%	Assume no
Timeout / IOEDC Error	100%	Based upon agreement that this failure mode is not a customer issue
NMD - Reclaim TGAs	77%	Based upon Suzhou/Koral input.

154k (1.54%)

SN	PFL#	Failing Head	Symptom	tff (hrs)	RD_SN	Proposed Screening Location	Proposed Screen(s)	Yield Impact at Location	Cut-In Date (Tentative)
81DCH93Y	PFL-3205	1	Head Instability	53.7	A1508F0V1	ET	WAITA(15 max)+SERIAL_F3(1700 max)	0.08%	Expect 8TH Out-in on Feb 7
81P04V9R	PFL-3209	5	Head Instability	62.5	A1508F0V1				
W1D0C9W4	PFL-3205	1	Head Instability	285.3	A1508C0B1				
W1D09BNP	PFL-2954	1	Degraded Head	297.1	A1507PHK1	ET Drive CERT	TP_MAX(P12)max) RAW_ERROR_RATE<0.1	0.07% ~1%	Expect 8TH Out-in on Feb 7 Paper Sort - PCO 17.4
W1D0C41T	PFL-3208	1	Degraded Head	162.3	A1508F3N1	ISI Drive CERT	SMAN_BMP_MAX>1700 and SMANMAX_MAX_MAX > 2000 RAW_ERROR_RATE<0.1	0.39% ~1%	Expect PNG out-in by Feb 9 Paper Sort - PCO 17.4
W1E0V4K	PFL-3205	1	Degraded Head	151.5	A1508FVTH	ET Drive CERT	TP_PLUMN(2min)+CTD_NORM(NS10.13max) RAW_ERROR_RATE<0.1	0.38% ~1%	Expect 8TH Out-in on Feb 7 Paper Sort - PCO 17.4
Z1P0CE0K	PFL-3202	5	Degraded Head	411.9	A1508G0V1	ET Drive AGG	TP_PLUMN(2min)+TQ0_SIN(12.3 max) Possibly preventive CERT for E010504 along with other potential ECs	0.02% None	Expect 8TH Out-in on Feb 7 Drive PS Team working issue
Z1P0C4S5	PFL-3204	2	Degraded Head	98.7	A150G41T1	Drive CERT	MAX_JUMP+140 in P35 AGG BASELINE_JUMP for ACTIVE_HEATER=V DELTA_BURNISH_CHECK+5 in PLAFH_PH_BURNISH_CHECK for	~1%	Paper Sort - PCO 17.4
Z1P0ELMT	PFL-3202	1	Degraded BER	55.0	A150240Z1	Drive CERT	ACTIVE_HEATER=0 and STATE_NAME=AFH and TEST_TYPE=BURNISH	~0.02% Head level drive failure	Paper Sort - PCO 17.4

Clearing Action

Responsibility for Clearing: Hari N, Krishnan S, Thanit S, Brijesh S, Frank M, Sherwin, Wilson & Niran L.

Clearing Action:

1. FIS crunch and quarantine affected drive -- Sarun / Sherwin / HongGang -- Feb 06 est
2. Re process affected vinatage and new build drive with PCO 17.3A
3. Develop paper sort criteria for Head related failure -- Feb 07 est
4. Packout Block re claim TGA .
5. Servo code fix- Feb 10.

Locations Affected	
Locations Affected: Site Affected Location(s) Affected: FGI, WIP	
Conditional Releases	
<p>1. CONDITIONS FOR THE RELEASE: Allow to ship SSO vintage drive after screening for degraded / unsatable head failure mode. Screen creteria are: HGA Electrical test screen criteria 1. WIJITA(15max) + (V23)SGR行为F3(1,700max) 2. TP_NLUMP(20max) 3. TP_PLUMP(-2min) + TCO_SLN(2.2max)+CTQ_NORM_NSE(0.13max) Slider Electrical Test Screen Criteria 1. SMAN_AMP_AVG > 1700 and SMAN_MAX_MAX>2100 Drive Cert Test screen criteria 1. RAW_BER <2.1 (P_FORMAT_ZONE_ERROR_RATE) 2. MAX_JUMP>140 in P135_BASELINE_JUMP for ACTIVE_HEATER=W 3. DELTA_BURNISH_CHECK>-5 (in P_AFH_DH_BURNISH_CHECK for ACTIVE_HEATER=R,STATE_NAME=AFH3,TEST_TYPE=BURNISH) 4. P186 Delta Reader Bias (PRE2-CAL2) >47 (Possibility prevent re-CERT for EC10504 along with other potential Ecs)</p> <p>- No Alphana 1D on Disty / OEM configuration.</p> <p>Release composed by: Brijesh KU Singh on 2/7/2012</p>	<p>Approved By: Brijesh KU Singh on 02/07/2012</p>

Form: SSO99 02/04/2012 10:00:14 PM

Grenada Seagate Confidential

EXHIBIT 66

Message

From: Anik Rubalcava-Capretta [anik.rubalcava-capretta@seagate.com]
Sent: 12/15/2011 7:02:10 PM
To: Dave M Rollings [dave.m.rollings@seagate.com]
Subject: Fwd: Drives not being detected

FYI -

----- Forwarded message -----

From: **Mike S Carlow** <mike.s.carlow@seagate.com>
Date: Thu, Dec 15, 2011 at 10:56 AM
Subject: Re: Drives not being detected
To: John W Bornholdt <john.w.bornholdt@seagate.com>
Cc: Keith Myers <keith.r.myers@seagate.com>, Anik Rubalcava-Capretta <anik.rubalcava-capretta@seagate.com>

John,

Grenada FW is now rolling to CC49 and should be available Monday. Once its available we will send a FW load package. At first glance at the FW changes they don't highlight and detection fixes.

We can try this new FW and go from there.

Mike

On Thu, Dec 15, 2011 at 11:15 AM, John W Bornholdt <john.w.bornholdt@seagate.com> wrote:
Hi Mike and Keith,

I understand that we're working on a firmware roll for the Grenada 3TB desktop drive. We got a large channel customer who has delivered several systems to Netflix with the 3TB drive, and they are failing at a very concerning rate. Netflix and Equus are both very anxious about what is happening, and it sounds like the firmware roll might address the issue. Is there anything we can do to expedite firmware delivery for Equus to validate the fix and keep these important customers in the fold?

Thanks,
John

John Bornholdt
Seagate Technology | Channel Sales - Central U.S.
Office: 952-923-1008 (*new office number*)
Mobile: 612-845-3695

----- Forwarded message -----

From: **John Dotson** <jdotson@equuscs.com>
Date: Thu, Dec 15, 2011 at 11:13 AM
Subject: RE: Drives not being detected
To: Anik Rubalcava-Capretta <anik.rubalcava-capretta@seagate.com>, "dave.m.rollings@seagate.com" <dave.m.rollings@seagate.com>

Cc: Will Wu <WWu@equuscs.com>, Tim Poor <TPoor@equuscs.com>, "john.w.bornholdt@seagate.com" <john.w.bornholdt@seagate.com>, Netty Ng <NNg@equuscs.com>, Eddie Ramirez <eramirez@equuscs.com>

Anik,

Did the firmware division give you an idea as to when the CC47 firmware will be available and released to you?

John

From: Anik Rubalcava-Capretta [mailto:anik.rubalcava-capretta@seagate.com]
Sent: Thursday, December 15, 2011 8:57 AM
To: John Dotson; dave.m.rollings@seagate.com
Cc: Will Wu; Tim Poor; john.w.bornholdt@seagate.com; Netty Ng; Eddie Ramirez

Subject: Re: Drives not being detected

Hi John,

I just left you a voicemail.

The new firmware revision is not available yet. I am waiting for firmware to send the firmware package.

As soon as I receive it, I will provide it to you as well.

Best Regards,

Anik

From: John Dotson [mailto:jdotson@equuscs.com]
Sent: Thursday, December 15, 2011 10:12 AM
To: John Dotson <jdotson@equuscs.com>; 'Anik Rubalcava-Capretta' <anik.rubalcava-capretta@seagate.com>; Dave M Rollings <dave.m.rollings@seagate.com>
Cc: Will Wu <WWu@equuscs.com>; Tim Poor <TPoor@equuscs.com>; 'John W Bornholdt' <john.w.bornholdt@seagate.com>; Netty Ng <NNg@equuscs.com>; Eddie Ramirez <eramirez@equuscs.com>
Subject: RE: Drives not being detected

Anik,

May I have an update this morning? The drives we sent to the customer are "failing" in large volumes, even though we pre-tested them before they shipped, and even though the customer pre-tested them before shipping to their end locations.

John

From: John Dotson
Sent: Wednesday, December 14, 2011 2:45 PM
To: 'Anik Rubalcava-Capretta'

Cc: Will Wu; Dave M Rollings; Tim Poor; John W Bornholdt; Netty Ng; Eddie Ramirez

Subject: RE: Drives not being detected

Anik,

Thanks for the update. The firmware CC47 must have just been released in the last couple of weeks, because you checked for me on 11/21 and there was not a firmware at that time.

Can you provide me the firmware and the release notes for CC47?

On the desktop platform I was testing the drive on, the boot time is pretty quick, and with those "failing" drives connected the motherboard would wait for about two minute and then time out. The other platform we are using takes from a cold boot about 20 seconds before it initializes the HBA firmware. If we disable the HBA firmware and let the system boot up, and then allow the driver to initialize the drives are still missing.

The OS the customer is using is freeBSD 9, but we are testing at the BIOS level, Windows XP and WinPE with the same results of not detecting at P.O.S.T.

John

From: Anik Rubalcava-Capretta [mailto:anik.rubalcava-capretta@seagate.com]

Sent: Wednesday, December 14, 2011 2:08 PM

To: John Dotson

Cc: Will Wu; Dave M Rollings; Tim Poor; John W Bornholdt; Netty Ng; Eddie Ramirez

Subject: Re: Drives not being detected

Hi John,

We retested the drives several times and were able to reproduce the issue.

It is an interesting issue because when we hook up our internal test tool to the drives, the drives power up consistently with no problems. If I remove the internal test tool the drives will fail to be recognized.

What OS are the drives used in? Are you aware how much time is allowed to spin-up?

The drives have an older revision of firmware, the latest revision is CC47. The next step will be to load the latest firmware and retest the drives.

After testing with the latest firmware revision, the next step will be to capture a bus trace of the failure. A bus trace will allow us to see what commands are being sent to the drive and how the drive is responding.

Best Regards,

Anik

On Wed, Dec 14, 2011 at 11:04 AM, John Dotson <jdotson@equuscs.com> wrote:

Anik,

Our customer is asking us for an update. Has your engineer been able to get any of the other QTY.4 drives to fail? Has he been able to analyze the problem with the drive that failed?

We have no shortage of drives that have cold boot problems, if you need more samples.

We did a quick power on test of the drives right after opening the packaging of 144 drives, and found 17 drives that were not detected upon a cold boot. After mounting the "good" drives into the systems, we are finding that some of those drives have cold boot problems.

Please advise if you need any more information or details from us to help in troubleshooting this issue.

John

From: John Dotson

Sent: Tuesday, December 13, 2011 2:32 PM

To: 'Anik Rubalcava-Capretta'

Cc: Will Wu; Dave M Rollings; Tim Poor; John W Bornholdt; Netty Ng; Eddie Ramirez

Subject: RE: Drives not being detected

Anik,

All the drives that we had sent were tested upon a second separate platform. It appeared that upon a cold boot (not having power applied to them for several minutes) the drives would not be detected, but then after a warm boot the drives were subsequently detected. If we powered the system down for a few minutes and then back on, the drive would exhibit the same behavior of not be detected again.

If a drive does not spin up or has a delayed spin up, would that information be stored in a log on the drive?

I have moved these drives to other platforms, and the "detection" problem follows the drives.

John

From: Anik Rubalcava-Capretta [mailto:anik.rubalcava-capretta@seagate.com]

Sent: Tuesday, December 13, 2011 2:27 PM

To: John Dotson

Cc: Will Wu; Dave M Rollings; Tim Poor; John W Bornholdt; Netty Ng; Eddie Ramirez

Subject: Re: Drives not being detected

Hi John,

I tied off with Dave regarding your drives.

Four of the five drives sent are recognized by the interface. In reviewing the log files, the drives are clean and do not show any errors or problems.

Only 1 drive had trouble being recognized by the interface. This drive requires further analysis. We are working on it and will provide an update as soon as possible.

Thanks and Best Regards,

Anik

On Tue, Dec 13, 2011 at 2:14 PM, John Dotson <jdotson@equuscs.com> wrote:
Dave,

Have you had a chance to analyze the drives? Do you have any questions that I can answer for you?

John

From: Will Wu
Sent: Friday, December 09, 2011 5:33 PM
To: 'Dave M Rollings'; Tim Poor

Cc: Anik Rubalcava-Capretta; John Dotson; John W Bornholdt; Netty Ng; Eddie Ramirez
Subject: RE: Drives not being detected

Hi Dave,

Shipped today
Here is the tracking number

1Z68W0A40166225183

Should get there on Monday

Thanks

From: Dave M Rollings [<mailto:dave.m.rollings@seagate.com>]
Sent: Friday, December 09, 2011 9:07 AM
To: Tim Poor
Cc: Anik Rubalcava-Capretta; John Dotson; John W Bornholdt; Netty Ng; Eddie Ramirez; Will Wu
Subject: Re: Drives not being detected

Hi Tim,

Thanks for the update. I will look for the drives on Monday.

Have a nice weekend.

dave

Dave Rollings

Field Applications Engineering
Seagate Technology
10200 S. De ANZA Blvd,
Cupertino, Ca 95014
Cell 408 218 3013

On Thu, Dec 8, 2011 at 9:53 PM, Tim Poor <TPoor@equuscs.com> wrote:
Anik/Dave,

The drives did not make it out of our facility tonight, so they will ship tomorrow for Monday morning delivery.

Thank you,

Tim

From: Anik Rubalcava-Capretta [<mailto:anik.rubalcava-capretta@seagate.com>]
Sent: Thursday, December 08, 2011 5:29 PM
To: Tim Poor; Dave M Rollings
Cc: John Dotson; John W Bornholdt; Netty Ng; Eddie Ramirez
Subject: Re: Drives not being detected

Hi Tim,

Please ship 2-5 failing drives to the following address:

Seagate Technology
Attn: Dave Rollings
10200 South De Anza Blvd.
Cupertino, CA 95014

Thanks and Best Regards,

Anik

On Thu, Dec 8, 2011 at 3:01 PM, Tim Poor <TPoor@equuscs.com> wrote:

Anik,

We are building up seven of the systems for our large customer with 36 of the ST3000DM001 3TB drives in each system. We have had a number of hard drives that aren't recognized by the system at boot. Some drives will be recognized sporadically during multiple reboots, but others are not recognized as all. As a part of our troubleshooting process, we have moved the failed drives to a standard desktop system based on an Intel branded motherboard to see if the drive is recognized. Some of these drives are also not being recognized by the Intel board.

We would like to overnight a sampling of these failed drives to you to check the SMART system logs for any failure flags.

This level of hard drive failures is a severe concern for us, and we need to get to the bottom of this as quickly as possible.

Please let me know who/where we need to ship these drives for analysis.

Thank you,

Tim

Timothy Poor

Director, Field Application & Sales Engineering

Equus Computer Systems, Inc.

5801 Clearwater Drive

Minnetonka, MN 55343

O: 612-617-4317

F: 612-617-6298

tpoor@intequus.com

--

Best Regards,

Anik

Anik S. Rubalcava-Capretta

Sr. Customer Technical Support Engineer

Mobile: 949.315.1951

Email: Anik.Rubalcava-Capretta@seagate.com

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Best Regards,

Anik

Anik S. Rubalcava-Capretta
Sr. Customer Technical Support Engineer
Mobile: 949.315.1951
Email: Anik.Rubalcava-Capretta@seagate.com

Best Regards,

Anik

Anik S. Rubalcava-Capretta
Sr. Customer Technical Support Engineer
Mobile: 949.315.1951
Email: Anik.Rubalcava-Capretta@seagate.com

--

Best Regards,

Anik

Anik S. Rubalcava-Capretta
Sr. Customer Technical Support Engineer
Mobile: 949.315.1951
Email: Anik.Rubalcava-Capretta@seagate.com